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of Engineers  
Engineer Institute for  
Water Resources

DELFT HYDRAULICS  
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# Report of the Inland Waterway Transport (IWT) Mission

5 February-20 April 1985

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Main Report

1. Page 9, paragraph 2.2.2, first sentence, change existing bridges to planned bridges.
2. Page 23, sentence 14, delete the word first.
3. Page 52, sentence 3, change 70 projects to 71 projects.
4. Page 53, heading C) Important (45) to Important (47) and delete line 18 The marketing of IWT services. (11).
5. Page 65, last paragraph, line 4, change 9 critical and 18 highly to 8 critical and 16 highly.
6. Page 72, last paragraph, line 3, change 9 projects as critical, 18 projects as highly important and 44 as to 8 projects as critical, 16 projects as highly important and 47 as.
7. Page 83, sentence 3, change Kalabagn to Kalabagh.
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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

REPORT OF THE INLAND WATER TRANSPORT (IWR) MISSION

(February - 20 April 1985)

by

Jerome Delli Priscoli, Ph.D.

John Moon, Ph.D.

Pieter von Groen

James Bradley

Clarence Fujii

Main Report  
June 1985

Summary Report 85-SR-5a

# TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	IX
1. INTRODUCTION .....	1
1.1 Objective of Mission .....	3
1.2 Method and Approach .....	3
1.3 Why IWT Is Important to the ESCAP Region .....	5
2. BACKGROUND OF IWT AND PROBLEMS AND ISSUES FOUND IN EACH COUNTRY .....	7
2.1 Introduction .....	9
2.2 Bangladesh .....	9
2.2.1 Background .....	9
2.2.2 Observations of Problems and Issues .....	9
2.3 Burma .....	11
2.3.1 Background .....	11
2.3.2 Observations of Problems and Issues .....	12
2.4 China .....	14
2.4.1 Background .....	14
2.4.2 Observations of Problems and Issues .....	15
2.5 Indonesia .....	17
2.5.1 Background .....	17
2.5.2 Observations of Problems and Issues .....	18
2.6 Malaysia .....	19
2.6.1 Background .....	19
2.6.2 Observations of Problems and Issues .....	20
2.7 Pakistan .....	21
2.7.1 Background .....	21
2.7.2 Observations of Problems and Issues .....	22
2.8 Philippines .....	22
2.8.1 Background .....	22
2.8.2 Observations of Problems and Issues .....	23

2.9	Sri Lanka .....	25
2.9.1	Background .....	25
2.9.2	Observations of Problems and Issues .....	25
2.10	Thailand .....	26
2.10.1	Background .....	26
2.10.2	Observations of Problems and Issues .....	27
3.	REVIEW OF THE MISSIONS'S OBSERVATIONS OF IWT ISSUES IN THE ESCAP REGION, THE REGION'S CAPACITY TO DEAL WITH THESE ISSUES RECOMMENDED PROJECTS FOR THE REGION .....	29
3.1	Introduction .....	31
3.2	Eleven Subject Area Classification Scheme .....	31
3.3	Review of Issues, Capacity and Recommended Projects by Eleven Subject Areas .....	35
3.3.1	Water Management .....	35
3.3.2	Planning and Organization .....	36
3.3.3	Socio-Economic Aspects of IWT .....	38
3.3.4	Hydraulics and Sediments .....	39
3.3.5	Surveying .....	40
3.3.6	Dredging Technology .....	41
3.3.7	Engineering Issues .....	42
3.3.8	Navigation Issues .....	43
3.3.9	Vessel issues .....	44
3.3.10	Terminals, Ports and Harbors .....	45
3.3.11	Operation Issues .....	46
4.	CLASSIFICATION AND PRIORITIZATION OF RECOMMENDED IWT PROJECTS .....	49
4.1	Introduction .....	51
4.2	Recommended Projects .....	51
5.	ELABORATION OF THE RECOMMENDATION FOR AN INLAND WATERWAYS TRANSPORT (IWT) CENTRE .....	57
5.1	Rationale for a Regional IWT Centre .....	59
5.2	Functions of a Regional IWT Centre .....	59
5.3	Organization and Funding of an IWT Centre .....	60
5.3.1	Alternative One: Full-scale, Centre of Expertise .....	60
5.3.2	Alternative Two: Small-scale, Approach with Mobile Core Staff .....	64

5.4	Comparison of Alternatives One and Two .....	65
5.5	Generic Problems with Establishing Regional Centres ....	66
5.6	Special Concerns to be Addressed if a Centre is located in Bangladesh .....	66
6.	SUMMARY AND CONCLUSIONS .....	69
7.	BIBLIOGRAPHY .....	75

#### APPENDICES\*

- A. Terms of Reference Contract
- B. List of Interviewees
- C. Team Members
- D. Country Background Descriptions
- E. Project Documentations
- F. Basis of Personnel/Resource Calculation for IWT Study Centre

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## EXECUTIVE SUMMARY.

The 1985 ESCAP Inland Water Transport (IWT) mission was given the task of listing problems and constraints within present inland water transport systems in the ESCAP region. This mission was also asked to evaluate solutions and potential projects to deal with the identified issues and problems. These objectives were achieved between 4 February and 20 April 1985. This report to ESCAP represents the substantial consensus of the five Non-ESCAP staff members of the mission on these objectives.

During the 2-1/2 month period, the mission interviewed more than 160 IWT officials as it visited the following nine countries in the ESCAP region: Bangladesh, Burma, China, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand. Since official clearance was not obtained, India was not visited. More than 160 important IWT problems and issues were identified by the mission and documented in this report. To deal with these identified issues and problems over the next 10 years the mission developed and documented 71 recommended projects.

Some type of regional centralization of IWT support activities is the best way to accomplish all 71 projects. In this report, the mission describes two alternatives: A large-scale, full-service regional centre or a small-scale organization with a highly mobile staff and outside consultants. Both approaches are explained in this report.

IWT has not received sufficient bilateral assistance or attention of donor organizations. Also, the IWT sector is probably the least visible of all the transport sectors. IWT requires greater marketing efforts to increase public awareness of its importance and potential. IWT often receives a much lower proportion of transport budgets than its actual share in the transport sectors. In many cases, IWT is critical to established patterns of social communication, transport and national development goals.

This mission reaffirms what several previous missions asserted. IWT is important to the ESCAP region.

The mission strongly states that: The first priority of ESCAP should be to implement the 71 recommended projects, and that the implementation process should begin as soon as possible. Discussion and deliberations concerning a possible Regional IWT Centre should not hinder or delay the beginning of this implementation process.

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\* The views expressed in this report are those of the mission team members and do not necessarily represent the views of the team members employing organization or those of UNDP or ESCAP.



CHAPTER 1

## CHAPTER 1. INTRODUCTION

### 1.1 Objectives of Mission

The 1985 ESCAP-IWT mission was charged with the following four objectives. (Ref. Appendix A):

- a. Obtaining a comprehensive list of problems and constraints which limit the ability of the present inland waterway systems in riverine countries of the ESCAP region to support important national objectives;
- b. Evaluating potential solutions;
- c. Assessing opportunities for inland waterway improvements which could be addressed during the next ten years; and
- d. Drafting the relevant project documents.

Objective a. is addressed primarily in Chapters 2 and 3, while b. and c. are addressed in Chapters 3 and 4. Project documentation, as stated in objective d. is found in Appendix E. The analysis to meet these objects was done in connection with United Nations' Development Program's (UNDP) preparatory assistance for the possible establishment of a Regional Centre for Development of Inland Water Transport, in Bangladesh. Therefore, Chapter 5 discusses, in detail, the specific recommendation of an Inland Water Transport (IWT) Centre. During the mission's visit to Bangladesh, members visited possible Centre facilities and discussed a Centre's future operation with officials of UNDP, donor organizations and the Bangladesh Government. Chapter 5.5 discusses the mission's impressions on this topic. A regional centre was not specifically discussed during the mission's visits to other countries. This mission was not asked to, and did not engage in, assessments of optional locations of a centre.

### 1.2 Method and Approach

From 1977 to the present, several previous reports, missions and discussions have addressed the regional problems of IWT along with the region's capacity to solve these problems. An IWT Centre has, to varying degrees, been addressed in most of this work. The 1985 mission was asked to take a "fresh" look at IWT problems, solutions and a potential centre site.

In the spirit of this philosophy, the 1985 ESCAP-IWT mission visited the following countries in the ESCAP region: Bangladesh, Burma, China, Indonesia, Malaysia, Pakistan, Philippines, Sri Lanka and Thailand. More than 150 IWT officials in these countries were interviewed. Because official clearance was not received, the mission did not visit India. Nevertheless, more countries were visited and probably more officials interviewed by this mission than any previous IWT mission. The visits, deliberations and report production were completed between 5 February 1985 and 20 April 1985. Also, the 1985 mission was larger and included a broader range of professional disciplines than previous IWT missions. The five-member

mission was broadly interdisciplinary. It included experienced IWT professionals with backgrounds in construction/operations, economics, social science, policy analysis, engineering, hydraulic research on rivers and structures, hydrographic surveying, and navigation. the members of the mission were from the Netherlands and the United States and worked for line organizations dealing with IWT operations.

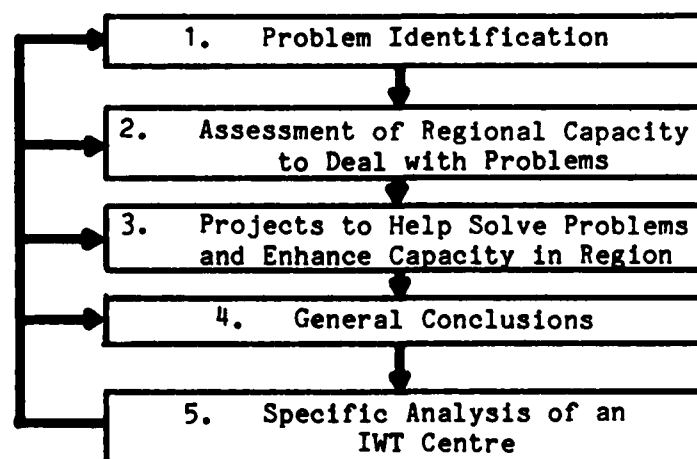
The mission team members were: Dr. Jerome Delli Priscoli, Senior Policy Analyst, Institute for Water Resources, U.S. Army Corps of Engineers; Dr. John Moon, Senior Project Manager, Maritime Research Institute, Netherlands; Mr. Pieter van Groen, Senior Project Engineer, Delft Hydraulics Laboratory, Netherlands; Mr. James Bradley, Assistant Chief of Construction/Operations, South Atlantic Division, U.S. Army Corps of Engineers; and Mr. Clarence Fujii, Deputy Chief, Engineering Division, Pacific Ocean Division, U.S. Army Corps of Engineers.

The ESCAP staff assisting the team were: Mr. Chu Guo Shu, Economic Affairs Officer, Division for Shipping, Ports and Inland Waterways, and Mr. Jean-Marc Deplaix, Inland Water Transport Expert, Division for Shipping, Ports and Inland waterways. They assisted deliberations of the team members and led the official mission visits.

Interviews, site visits, previous reports and ESCAP briefings were the primary sources of study information. To sift through this information and to build consensus efficiently, the mission team used an iterative process. Through facilitated group discussions, the team went through the complete study "thought process" several times and produced several preliminary draft reports.

The following thought process was used to facilitate team discussion and report production:

FIGURE 1 Thought Process Followed by the Mission



In general, interviews, individual reading, and group brainstorming were used in Step 1, Problem Identification. The team developed a list of eleven important IWT subject areas and used this list to summarize their observations of IWT problems, issues needed and project recommendations. These subject areas are: Water management; Planning and Organization; Socio/Economic Aspects; Hydraulics and Sediments; Surveying; Dredging Technology; Engineering; Navigation; Vessels; Terminals, Ports, and Harbors; and Operations. The relations between the subject areas are described in paragraph 3.2. Each subject area is fully explained and documented in Appendix E.

Interviews, individually generated ideas and brainstorming again provided the means to Step 3. General conclusions were the product of individually generated ideas followed by standard brainstorming. Finally, Step 5 used previous studies, specific briefings and specific team member experiences with similar centres.

By "iterating" in this way, the team was able to discuss specifics without losing sight of the total picture. Team members had time to reflect individually and collectively on the total picture as the study developed, and not just in a final hours "rush" at report completion. While each member of the mission does not necessarily agree equally with each item, the overall report represents the substantial consensus among the team members.

### 1.3 Why IWT is Important to the ESCAP Region

At the bottom line, members of the 1985 ESCAP-IWT mission feel that IWT is important to the ESCAP region for the following reasons:

- IWT can be an inexpensive but effective tool for a social policy of stemming urban concentration and encouraging decentralized industry development in the countryside;
- IWT can improve socio-economic environments;
- IWT is often an energy saver;
- IWT can help to develop and open areas not now easily accessible;
- In many places, much of the population is rural and poor and IWT is often the only means of communication and transport;
- IWT is important to the socio-economic fabric of most countries in the region, but often is not shown in country statistics;
- IWT is an appropriate technology which offers opportunity for incremental investment in social development and which will minimize social disruption and trauma; and, can provide a means of technology transfer among countries;
- If IWT is considered with other water resources, then incremental costs of providing IWT will be low;

- Specific regional conditions frequently make the economics of IWT in this region more favorable vis-a-vis roads and railroads because:
  - Cost per/km for road maintenance is high due to overloading, soil conditions, poor design and flooding;
  - Many potentially navigable waterways are now in place;
  - Many major markets in the region are already close to waterways;
  - Population tends to concentrate along waterways;
  - In Asia there is not as much time difference in journeys between IWT and other modes and the time differences that do exist do not have the same importance as in Western countries;
- IWT is a major, but uncounted employer, in many countries of the region;
- Reducing or failure to improve IWT will be harmful to the economic base of many countries in the ESCAP region;
- IWT is one of the primary means of transport within various ESCAP countries;
- Improvements in IWT can also enhance a country's self-reliance and self-sufficiency.

This mission reaffirms what several previous missions asserted: IWT is important to the ESCAP region. IWT has not received sufficient bilateral assistance or attention of donors such as the World Bank and the Asian Development Bank. Also, as previously stated, the IWT sector is probably the least visible of all transport modes. IWT requires greater marketing efforts to increase public awareness of its importance and potential.

CHAPTER 2

CHAPTER 2 - Background of IWT Problems and  
Issues in Countries Visited

2.1 Introduction

This chapter describes for each country visited, the general IWT background, and lists the specific issues observed by the mission. To generate general background information, the mission used reports available to ESCAP and information from the interviews. Full background descriptions are given in Appendix D. The brief backgrounds, summaries and observations presented in this chapter are summaries of this appendix.

2.2 Bangladesh

2.2.1 Background

- The country is comprised of flat low-lying land with numerous rivers.
- One-third of the country is flooded part of the year.
- The country's three major rivers are: Brahmaputra (Jamuna), Meghna and Ganges (Padma).
- Rivers are alluvial in character, flat, sandy and meandering.
- There are about 3,500-5,000 km of navigable waterway.
- The IWT fleet is comprised of a few thousand mechanized registered boats and several hundred thousands non-registered country boats.
- IWT carries more than 50 percent of total commerce.
- The Number of ships and the amount of cargo transported is very uncertain, especially in the country boat sectors.

2.2.2 Observations of Problems and Issues

- Inadequate air clearance or width of existing bridges creates hazardous conditions in a few areas for craft traversing the inland waterways.
- Reluctance to accept standardized or new design of vessels has slowed the growth and efficiency of IWT.
- Some vessel's design draft exceed the navigable depths of the river, and therefore, their use is not optimized.
- There is little or no information on commerce carried by country boats, which distorts the view of the importance of this craft and its contribution to the country.

- Congestion of IWT and ferry terminals has resulted in long delays in the shipment of commercial cargo and passengers and has created unsafe conditions.
- The full economic benefits cannot be obtained by the present fleet because of its age, poor equipment and vessel maintenance.
- Country boats experience long delays in loading and unloading at ports due to insufficient dock space.
- Cargo loading and unloading is extremely slow due to the inadequate amount of mechanized cargo handling gear.
- There is a shortage of trained personnel on hopper and pipeline dredgers.
- Material disposal operations are inefficient.
- The poor selection of dredgers for job requirements reduces production and fleet management.
- Inadequate maintenance performed on some country boat routes in the upper reaches of the rivers causes loss of commodity transport efficiency.
- There is a large amount of sedimentation and a strong meandering of the waterways. Also, there has been an increase of sedimentation in the last decades.
- Flood waters disrupt IWT operations.
- IWT and water institutions are fragmented which causes coordination problems. IWT is only incidentally included in the Master Planning Organization's (MPO) national water plan.
- As a result, proposed hydraulic control structures will not permit IWT.
- There appeared to be insufficient cooperation with the upstream and downstream countries on transboundary rivers.
- Administration and organization of country boats within the government is fragmented and weak.
- Population is concentrated in urban areas.
- IWT has a low priority among the various water users. For example, in the current study of water resources, IWT is considered as a constraint and not a variable. Better cooperation and coordination between users is consequently essential.



- The relatively low priority of IWT has meant that, in some cases, resources have not been made available to strengthen mid-level management. In addition, there are only a small number of experts in each area of IWT operations.
- Bangladesh has the opportunity to undertake inland water/coastal water cargo transfers at the two deep-sea ports of Chalna and Chittagong. However, this could be strengthened and consequently requires further investigation.
- One of the operations which hampers water-to-water transfers, especially with containers, is customs procedures.
- Considerable congestion also occurs at ferry crossings, such as seen at Aricha--where trucks wait 2-3 days on average and 4-5 days if there is a ferry breakdown.
- Much data is collected on the mechanized sector of the IWT fleet; however, there is little data on the country boat sector even though this sector may be carrying twice as much cargo.
- A number of sample surveys have been conducted on IWT traffic. The results of this work were encouraging; however, more work in the area is required.
- A large proportion of recorded cargo movements are carried by IWT. This proportion would be even higher if country boats were included in statistics. Nevertheless, IWT tends to be less visible than other modes of transport and a strong marketing push would assist in improving this visibility.
- In the planning for water resources management, IWT is, at present, hardly represented. The mission observed a clear need for IWT to become fully aware of the relevant planning techniques.
- Bangladesh has a system of charging for IWT services and facilities. The basis for these charges was, in some cases, established over 50 years ago and consequently the rationality of the pricing system has largely been overtaken by time.
- Similarly, IWT freight rates are, in some cases, set by the government. The rationality of the system used has been criticized and requires investigation.

## 2.3 Burma

### 2.3.1 Background

- Burma has a population of about 36 million
- It has a geographic area of 678,576 sq. km.

- The Irrawaddy River, 2,011 km, is the country's economic lifeline and major transportation system.
- The Irrawaddy River system includes the Irrawaddy, and the Chindwin, and their tributaries and connecting canals, covering 55 percent of the country. The total riverine system in Burma offers some 6,435 km of navigable waterways. Thirty-three percent of the 60 to 70 million tonnes of traffic is carried by small vessels and bullock cart.
- Most of the population is concentrated along the rivers.
- Total demand for cargo transport is about 60-70 million tons annually, of which 50 percent is carried by waterways.
- Private owners have about 2 or 3 craft each. Overall, the number of mechanized craft owned by private individuals is around 3,000 and the average size of a vessel is about 100 tons.
- The Irrawaddy is shallow during the dry season and during high seasons there is flooding and bank erosion.
- The change of water level is 30 to 40 feet.
- The Waterways Department, under the Ministry of Transport and Communications, was formed in 1972.
- The Waterways Department's main objectives are to improve and maintain rivers for safe navigation.
- Annual maintenance dredging is 1.1 million cubic meters, mainly in the main port of Rangoon.
- Major cargoes transported in IWT are gypsum, rice, cement, timber, petroleum products and general cargoes.
- About 1.5 million passengers were serviced by IWTC in fiscal year 1983-1984.
- IWTC had a fleet strength of about 640--excluding dredgers.
- The present fleet needs modernization, including re-engineering of vessels.
- Many wrecks remain from World War II and about 20 are commercially salvaged each year.

### 2.3.2 Observations of Problems and Issues

- Navigable passageways in many rivers continue to shift and may cause accidents.

- Hazardous navigating conditions are created by the lack of adequate aids to navigation.
- A number of long-tail boats were observed on the river.
- Recently, 100 barges have been provided with twin steerable propeller to cope with shallow water problems.
- Large numbers of wrecks and snags in the river have created hazardous navigation conditions and continue to increase the maintenance costs.
- Many of the vessels are old and lack the technological changes to make them operate efficiently and improve their maneuverability.
- There are inefficiencies caused by the inadequate number and poor quality of river port terminals.
- There is insufficient dredging capability to maintain depths during low water season causing loss of tonnage carrying capacity.
- There are constant alluvial river problems which hinder navigation such as sedimentation of channels and bank erosion.
- The Chindwin River Channel is too unstable for mass transport of coal.
- There is a lack of research with respect to pile screens.
- There is little water management planning.
- There is a lack of survey data and equipment for use in river surveys.
- There is little data collected on cargo carried by country boats.
- IWT development is not in proportion to its importance to everyday country life.
- When established in 1972, the Waterways Department was authorized to employ 4,500 staff. To date, only 25 percent of this number has been employed. Consequently, there are few well qualified personnel available for field work and management.
- There appears to be compartmentalization of responsibilities for river and vessel management. In the interests of IWT development, closer contacts should be maintained between the authorities.
- IWT is an important transport mode in Burma; however, modal split aspects need careful consideration in the transport planning process.

- Global statistics suggest that IWT is very important in Burma's domestic transport. Within the IWT sector, however, data is difficult to obtain as it is collected separately by such organizations as IWTC, PIC (Petroleum Industry Corporation) and BOC (Burma Oil Corporation). For the private sector (especially country boats), no significant data appeared to be available.
- From its inception, financial constraints have made it difficult for the waterways department to develop a fully comprehensive IWT plan.
- Individual IWT operators tend to plan for their own requirements, since there is no overall user plan.
- The Central Movement Coordination Committee (CMCC) controls all vessels over 100 tons. This control is effected by chartering vessels for most of the important cargo, vessels only receiving permits to purchase fuel if they have such a contract. Between Mandalay and Pagan, there are a large number of vessels alongside the banks, apparently out of service. Therefore, investigation of the means of planning the control of vessels is desirable.
- IWT freight rates on government cargoes are set by CMCC.
- Alternative means of transport between Rangoon and Mandalay are available.

## 2.4 Background and IWT Problems and Issues in China

### 2.4.1 Background

- China has extensive IWT system consisting of more than 5,600 navigable rivers totalling 108,000 km - 80 percent of which can be used all year round.
- The most important river system is the Changjiang (Yangtze)--the third longest river in the world--with a total length of 6,300 km. Other important river systems include the Zhujiang (Pearl River) and the Heilungjiang.
- Along a number of China's rivers, there are considerable seasonal variations in water levels - 30 meters not being uncommon. As a result, China has developed various indigenous techniques to overcome this and the associated river flow rate problems including special terminal designs and means of warping the vessels over rapids.
- The main ministry with responsibilities for IWT in China is the Ministry of Communications (MOC). The Changjiang and Heilunjiang have separate administrations under the MOC whilst their tributaries and other river systems fall under Provincial Bureaus of the MOC.

- Whilst China has the most developed inland waterway system of all the countries in the ESCAP region, many officials interviewed tend to compare their stage of development with IWT in Europe and the United States. In their views, many improvements can be made in all aspects of IWT.
- China has an extensive push-tow fleet with tows of 15,000 tons and even 32,000 tons regularly plying between Wuhan and Shanghai. Four years ago four 6,000 h.p. pusher tugs were delivered from the United States.
- River - coastal vessels have been introduced on a number of routes and interest is shown in developing this concept further.
- Transportation has a high priority in China's current development plans and IWT is either being used or is proposed to be used for transporting the country's bulk commodities (especially coal).
- China has extensive IWT passenger traffic, perhaps more than any other country. Consequently, China also has extensive experience and capability in IWT passenger vessel construction.

#### 2.4.2 Observations of Problems and Issues

- Over 1,000 existing dams do not have locks to accommodate boat passage and this limits the use of the rivers for commerce.
- Many of the upstream or tributary rivers have inadequate navigable depth for boats to carry commerce.
- Many accidents and unsafe vessel movements are apparently caused by the insufficient traffic control system in the rivers.
- Many of the rivers in the northern area are not navigable during winter months due to icing of the rivers.
- Navigable passageways in many rivers continue to shift and may cause accidents.
- The existing river barges cannot be used on the open sea.
- Inadequate telecommunication systems presently limit the full potential use of vessels. In some instances, vessels cannot navigate during reduced visibility times or night hours since they have no radar. This also decreases the safety aspects of navigating.
- The operation of the engine room of vessels is labour intensive and not efficient.
- Many of the vessels are old and lack the latest technological changes to operate more efficiently and to have better maneuverability.

- The poor design and layout of some river ports, especially in tributaries, cause inefficiencies in operation.
- The variation in water levels at port terminals results in inefficiencies in cargo handling. Cargo loading and unloading are slow due to the shortage of mechanized cargo handling equipment.
- There are some times inadequate operational and storage areas at major ports creating inefficiencies in operation.
- There is a high degree of siltation in many rivers which hampers navigation.
- There are constant alluvial problems such as meandering and bank erosion.
- A large amount of siltation is anticipated in the reservoir of Three Gorges Dam.
- Master planning on major river systems is not adequate.
- There is insufficient long-term IWT planning.
- In the near future, the increasing industrialization along the Changiang River may cause serious environmental problems. This environmental aspect is not yet fully considered.
- Hydrographic survey organizations are fragmented.
- While China has employed numerous low cost dredging schemes, they have not been documented for transfer to other countries.
- Planning of the best locations for industries and facilities along the river is lacking.
- Benefit-cost analyses for IWT are generally weak or nonexistent.
- There appears to be some lack of coordination between the various ministries concerned with water resources and power and IWT. In order to adopt the overall planning approach suggested in the introduction, it is necessary that this coordination be achieved.
- Data is available from the main shipping administrations on cargo movements. However, vessels outside of this sector are not included in the statistics. Country boats are not included in the statistics.
- Specific project appraisals are lacking for some of the smaller vessel operators including cost-benefit analyses of radar, VHF and dredging. For the waterways, technical-economic studies are lacking concerning the addition of locks to dams and barrages.

- China is clearly the leading country in the region in IWT transport. It has developed various technologies to meet some of the problems found in other countries of the region and is consequently in a position to assist them with these technologies.
- However, as was frequently noted by Chinese officials, China is lagging behind the developments in countries outside the region. The desire was expressed for cooperation in the form of direct links with authorities and IWT vessel operating companies, and education and training institution in advanced countries.

## 2.5 Indonesia

### 2.5.1 Background

- Indonesia consists of 13,000 islands.
- Inter island traffic is not considered as IWT; however, ferry transport falls under the Department concerned with IWT.
- On the main islands of Sumatra, Java, Kalimantan, Sulawesi and Irian Jaya there are many stable navigable rivers still in their natural state.
- In some rivers there are tidal bores.
- Along many rivers there are transmigration areas.
- In the transmigration areas the irrigation/drainage canals form the only means of transport.
- In transmigration areas IWT is essential for transport of cash crops and passengers.
- IWT is still in a development stage.
- Much improvement in IWT is expected from the IWT Training Centre which is under construction north of Palembang.
- Another major project proposed recently is an IWT study for Central and West Kalimantan.
- The country's administration emphasizes troubleshooting (in waterways where IWT is difficult) and ferries.
- No clear picture of the total transport in the main rivers exist.
- The different administrations dealing with waterways and IWT are not well coordinated.

### 2.5.2 Observations of Problems and Issues

- Lack of bank protection measures have caused loss of land, siltation, changes in river course and increased maintenance dredging costs.
- Large high water level fluctuations limit navigation in canals in transmigration areas to possibly only six hours per day.
- Debris in the form of logs and trees represent a hazard to navigation.
- Hazardous navigation conditions are created by the lack of adequate aids to navigation.
- The existing passenger fleet carrying capacity is not sufficient. Vessels are overloaded and sometimes unsafe.
- In some cases where new passenger vessels have been introduced, they have turned out to be unsuitable for their purpose.
- The reluctance of the private sector to accept the latest technology on boat design has contributed to the slow growth of IWT.
- Inadequate telecommunication and navigation systems presently limit the full potential use of vessels. In some instance, they cannot navigate during night hours. This decreases the safety of navigation.
- The existing passenger fleet is old and lacks the latest technological changes to operate more efficiently and with better manoeuvrability.
- Port terminals require large amounts of maintenance due to the lack of cathodic protection or protective coating.
- The variation in water levels at port terminals causes inefficiencies in cargo handling.
- Severe siltation is occurring at the river mouths and in the vicinity of ferry terminals which hampers navigation.
- Production on dredges is reduced due to lack of trained crews on dredging operations and equipment maintenance.
- There is insufficient dredging capability to maintain depths which causes loss of tonnage carrying capacity.
- Tidal bores are a hindrance to navigation.
- Lack of data on tidal hydraulics and sedimentation in irrigation/drainage canals in transmigration areas hampers planning efforts.



- There are no multi-use studies in most waterways.
- There is insufficient survey equipment for IWT organizations.
- Transmigrants depend on water transport between canals and the main river, which is only available for short periods of the day.
- Much information concerning the physical aspects of Indonesian rivers is available. However, it is located in different ministries and departments. Part of the data is collected by the Ministry of Public Works. This physical data needs to be extended and made available for other users.
- Some data is available on cargo movements. However, there is little information on the country boat sector.
- The planning and evaluation of IWT lacks a coordinated approach with, in some cases, the Ministries of Agriculture, Communications, Public Works and Transmigration Authorities undertaking independent studies. A broader approach to planning and project appraisal is recommended.
- In recognition of the importance of their IWT, Indonesia is establishing an IWT and Ferries Training Centre. There is a need for more expatriate trainers and additional financial support. Since the Centre will deal with practical training, it is recommended that the possibilities of having this Centre commissioning applied studies be investigated. Scientifically and financially this may be attractive.

## 2.6 Background and IWT Problems and Issues in Malaysia

### 2.6.1 Background

- On Peninsular Malaysia, it appears that IWT is mainly short distance. It is usually associated with ports. Knowledge of river entrances, especially if they are associated with a port, is relatively good, however, the extent of upstream knowledge is limited. Perhaps this is available from other ministries.
- There appears to be a lack of awareness at the Federal Government level in Kuala Lumpur of the importance of inland waterways in East Malaysia, especially Sarawak (state level).
- Sarawak has at least 32 rivers or waterways ranging in length from 3 to 306 miles.
- The longest river system is the Batang Rajang with a total length of 306 miles.

- The Hinterland of Sarawak has poor or non-existent road connections and consequently the rivers are the main means of transport.
- Part of the Malaysian Federal Government's stated policy includes the social and economic development of all members of society.
- Development of transport links to less developed areas is one means of achieving this policy objective, IWT being an obvious contender in Sarawak.
- One of the reasons for the low visibility of IWT in Sarawak is administrative; that is, IWT in Sarawak falls under the State and not Federal Government. For example, foreign assistance asked for by the state must be arranged federally.
- At present, there is no coordinated effort in Sarawak to investigate the development of IWT. This would require the participation of, inter alia, the State and Federal Marine Departments, Public Works Department, Drainage and Irrigation Department, Local Authorities and the relevant Port Authorities.
- Given the resource limitations, the state has a competent team of hydrographers, however they can only survey limited locations.

#### 2.6.2 Observations of Problems and Issues

- Hazardous navigation conditions are created by the lack of adequate aids to navigation.
- Lack of enforcement of traffic regulations has created unsafe passenger service and possibly some loss of life.
- There are inadequate operational and storage areas at major ports creating inefficiencies in operations.
- Severe siltation is occurring at the harbour mouths which hampers navigation.
- Relationships between river characteristics and IWT are not considered.
- Shooting the rapids is sometimes difficult in mid-sections of various rivers and hampers navigation.
- New planned structures, such as dams for hydropower, will affect IWT possibilities and require further investigation.
- Lack of physical data on upstream or river mouths hampers planning.

- Existing survey equipment is old. Eventual modernization is hampered by possible reorganization. The Survey Section may disappear, and the functions may go back to the navy.
- There is lack of data on country boats.
- Although the rationale for IWT development may ultimately be socio-economic terms, IWT does not appear in national and state planning documents.
- The central authorities in Kuala Lumpur appear not to have a clear view of IWT in Malaysia. This arises for two reasons: First, on Peninsula Malaysia rivers tend to fall under the irrigation authorities, while in East Malaysia IWT falls under the States. Second, the importance of IWT, especially to East Malaysia, including basic data, needs to be clearly identified.
- At present, there is no coordination body even at the state level for IWT. Before effective planning can begin, such a body needs to be established.
- On Peninsula Malaysia there is fragmentation of dredging operations between the irrigation authorities and marine authorities.
- In East Malaysia, within the limited funds available, IWT associated operations are undertaken. If, however, IWT is to be extended, there is a clear need for education and training of personnel.

## 2.7. Pakistan

### 2.7.1 Background

- The Indus River is a flat sandy alluvial river with five tributaries.
- There are five barrages and two dams (of which one is under construction) in the main river.
- Most of the river section from the mouth up to the second barrage (Sukkur is devoid of locks) is navigable only in the monsoon season.
- There exists a minimum of navigation between Sukkur and Kalabagh.
- IWT has been neglected for almost one century.
- There are plans to develop IWT in view of energy savings and foreign exchange. First between Qasim and Kalabagh, later in tributaries and irrigation canals.

### 2.7.2. Observations of Problems and Issues

- Near some of the existing barrages the passageway for IWT craft is not adequate.
- Inadequate air clearance or width of existing bridges creates hazardous conditions for craft traversing the inland waterways.
- No IWT fleet exists.
- Lack of IWT experience will hamper the rapid growth of the sector.
- There is degradation of the rivers downstream of barrages causing water depth problems above the downstream lock sills in the dry season.
- There are constant alluvial river problems which hamper navigation.
- Master planning for the Indus River to determine the feasibility of developing IWT is lacking.
- A full feasibility study would be expensive. Consequently, it may be desirable to undertake a pre-feasibility planning study.
- IWT has been more or less non-existent for the last 100 years. Consequently, all aspects of the planning process need to be developed.
- Forecasting of waterborne traffic (including modal split) needs to be further investigated.
- Additional hydrological field data (covering in main part of the river basin) needs to be obtained, especially.
- Given the non-existence of IWT for about 100 years, the IWT management expertise has been largely lost. Consequently, extensive exposure of staff to IWT management systems and education and training of staff will be required.

## 2.8. Philippines

### 2.8.1. Background

- The Philippines have a population of about 52 million, of which 9 million reside in Metropolitan Manila.
- The Philippines have over 7,000 islands, of which Luzon is the largest and on which Manila, the Capital of Philippines, is located.
- It's geographic area is over 300,000 sq. km.

- The three main harbours in Manila are the South Harbour for international shipping and trade; North Harbour for domestic operations and Manila International Container Terminal complex.
- Total shipcalls in 1984 were 13,890 with cargo traffic of 19.384 million metric tons.
- Domestic traffic is also handled along the banks of the Pasig River.
- In 1984, 854,807 metric tonnes of cargo traffic, not including direct domestic traffic, was in the Pasig River.
- The major commodities are steel and aluminum products, grain and cereals, refined sugar, molasses, fertilizer, ore and minerals, and petroleum products.
- Stevedoring services are privately owned and operated upon authorization of Philippines Port Authority.
- Average barge capacity operating in the Pasig River is 750 tons.
- More than 49 commercial enterprises are located along the banks of Pasig River.
- Twelve bridges span the Pasig River.
- The Pasig River is also used as a floodway.
- There is no proper dredging in the Pasig River -- only at it's mouth.
- Studies are going on to provide passenger river boat service along the Pasig River.
- The Pasig River water quality has deteriorated considerably.
- Observations are limited to Manila's operation; there are probably more inland waterways used for commerce in other parts of the country first.

#### 2.8.2 Observations of Problems and Issues

- The recently constructed bank protections along the Pasig River have failed in many locations and further failures are anticipated.
- Inadequate air clearance or width of existing bridges creates hazardous conditions for craft traversing the inland waterways.
- There is insufficient dredging capacity to maintain depths which causes loss of tonnage carrying capacity.

- Severe siltation is occurring at the mouth of the Pasig River which hampers navigation.
- No comprehensive plan exists for multi-use of Pasig-Laguna de Bay system.
- The existing water management study does not include the sluice and lock which were constructed later.
- There are environmental problems in the Pasig River.
- There is a lack of survey data.
- There is a lack of knowledge about passenger traffic potential in Pasig River. The current study of passenger traffic should convince private sector.
- From the organizations visited by the team and from the reports consulted, there is a clear need for a national waterway inventory. This data will facilitate the planning process.
- In the Pasig River there appeared to be a lack of coordination of activities. For example, it was not clear whether using the waters of Laguna de Bay to control pollution and sedimentation is currently examined.
- The PPA finds it difficult to collect statistics on traffic in the Pasig, especially for traffic making a direct entry into the river from other parts of the Philippines. Investigation of the most cost effective means of collecting such data is desirable.
- The Pasig River falls under the administration of the Manila Port Management Unit. In principle, there is a single stevedoring company for third party cargoes. This system is strongly criticized by users and requires investigation.
- The current financial difficulties of the Philippines have meant that foreign exchange controls have been introduced. This makes it difficult for the operators to obtain foreign equipment.
- The financial requirements of financing bodies in the Philippines are such that various cuts in costs have to be made. These cuts have been made in maintenance, a practice which could have serious implications in the future.
- Import restrictions have reduced IWT traffic in some commodities by one half.
- It is questionable whether the transport on the Pasig River should be classified under IWT. It can be considered as normal internal harbour transport into which it fits organizationally.

## 2.9. Background and IWT Problems and Issues in Sri Lanka

### 2.9.1 Background

- Sri Lanka has a network of canals and waterways which were constructed during colonial times with rather small locks and, in parts, limited cross sections.
- The waterways have had no significant transport function since the early 1950s and, as a result, some sections are heavily silted or dry.
- With the increase in fuel prices in the 1970s, a number of studies have been undertaken to assess the transport economics of the waterway system. One result has been a plan to redevelop, in three phases the Hamilton Canal which runs to the north of Colombo. The first phase has been completed.
- A study of the transport economics of the waterways system in 1981 was unfavourable to its development, however, some of the assumptions in the study have been criticized.
- One of the factors that needs careful considerations is that road, rail and a coastal route are available as alternatives to IWT.
- If development of the system is to proceed, then a full cost-benefit study which takes into account all of the canal uses including irrigation, drainage, tourism and social aspects would need to be undertaken.

### 2.9.2 Observations of Problems and Issues

- On some sections of the existing canal no width expansion capacity is available as it is hindered by rail on one side and road on the other side.
- Poor design and or construction has caused the bank protection along the canals to fail and it will continue to fail.
- Attempts have been made to rehabilitate some of the canals in Sri Lanka. For transport purposes, these attempts have been largely unsuccessful.
- It would appear that the rehabilitation of canals cannot be wholly justified on transport grounds, and, consequently, all the costs and benefits generated by such a project need further investigation.
- One of the factors influencing the previous observation is the availability of coastal routes, road and rail.

- Given the country's budget constraints, IWT appears to be in a relatively weak position and holds little government interest.
- Given the current status of IWT in Sri Lanka, the operational requirements will depend largely upon whether it is to be developed.
- Navigation is practically shut down due to lack of maintenance funds, and siltation causing outlets to sea ports to be closed off.
- There is a constant siltation of canals and there is no fundamental approach to the problem.
- Single use will not justify cost of maintenance or investments.
- At present, other use of canals is marginal.
- There are no significant survey activities.

## 2.10 THAILAND

### 2.10.1 Background

- Thailand has an even greater potential for inland water transport than is presently being exploited or contemplated in long range plans. The major river systems of the country are natural avenues of commerce which await more use.
- There are few inland ports and limited storage facilities.
- Barge standards are presently being updated in Thailand with push towing and steel construction being the major changes being adopted.
- There is an increase in commodity tonnages.
- Additional channel development projects are underway with more planned for the future.
- There needs to be a strengthening of the Harbour Department for better management of the inland river systems.



- Inland navigation is given low priority in the Ministry of Communications and in the National Budget process.
- There is a limited number of dredges to perform maintenance of the canal systems.
- There is significant encroachment along canals.
- Data collection and analysis on IWT are weak links in the overall system and hamper project justification in the long run.
- Multi-purpose uses are still not fully exploited in project justifications.
- There is little attempt to publicize the capacities of the rivers and canals to reduce the cost of commodity transport.

#### 2.10.2 Observations of Problems and Issues

- Canals provide flood control and navigation benefits; however, encroachment reduces these benefits and hampers future maintenance operations.
- The full economic benefits of push towing are not being realized on the rivers because most barges cannot be adapted to this method of towing.
- Maximum dredging capacity is not being realized due to the poor training of dredge crews. This is further impeded by poor equipment maintenance and training of maintenance personnel.
- Accurate data on vessel types, number and sizes and commodity movement cannot be obtained due to inadequate sampling techniques.
- The capacity of using the rivers for commodity transport is poorly publicized. The rivers are also underutilized due to the expense involved in changing modes of transport.
- Some of the methods used to dispose of dredged material fail to achieve long term results.

- There is a failure to include multi-purpose uses in the studies of barrage operations.
- The dredgers available do not have sufficient capacity to meet requirements, leaving the maintenance of the canal systems in poor condition. This impedes navigation. However, it could be alleviated through purchases of new dredges.
- The buoy system employed on the rivers is difficult to maintain due to the flow condition and debris.
- There is yet not confirmation on the effect of recent capital dredging on the amount of siltation.
- A number of studies have been undertaken for the development of IWT. These studies have used data from the mid-1970s which is extrapolated. There is a need for more recent data to be collected before major projects are undertaken.
- As with most countries, Thailand has difficulties in collecting statistics on country boats. The authorities expressed interest in a regional study on sample survey techniques.
- Thailand is currently undertaking a study into the pricing of IWT facilities.
- The management of waterways in Thailand falls under the Port Authority, Irrigation Authorities and Harbour Department of the Ministry of Communications. Some form of coordination between these bodies is required so that the waterways can be managed more effectively.
- While Thailand is rapidly adopting new technologies there is still a general need for training. One specific area is dredging management.

CHAPTER 3

### 3 REVIEW OF THE MISSION'S OBSERVATIONS OF IWT ISSUES IN THE ESCAP REGION; THE REGION'S CAPACITY TO DEAL WITH THOSE ISSUES; AND, RECOMMENDED IWT PROJECTS FOR THE REGION

#### 3.1 Introduction

In order to organize its observations and to explain the linkage between those observations and its recommended projects, the mission classified IWT into the following 11 subject areas: Water Management, Planning and Organization; Socio-economic Aspects; Hydraulics and Sedimentation; Surveying; Dredging Technology; Engineering; Navigation; Vessels; Terminals, Ports and Harbours; and Operations.

The issues and problems which members observed were separated into these subject areas. The mission then assessed the capacities of the region in each of these subject areas. Capacity was broadly assessed in terms of the region's research, training, applied studies and organizational resources as well as experience available for IWT. Based on these observations and the assessment of capacities, recommended projects were developed for the region which are also classified into the same subject areas. By using these 11 subject areas, the mission was able to look across individual countries and to paint a regional picture of IWT. The mission was then able to show the link between the issues they observed and the projects they recommended.

This chapter describes the substantive results of these activities as well as the rationale for using the 11 subject areas.

After explaining the rationale for the subject areas, the Chapter contains 11 sections, corresponding to each of the subject areas. Each of these sections are further divided into three parts: first, a review of issues in the subject area observed by the mission; second, the mission's assessment of the capacity to deal with these issues in the region, and ; third, a discussion of those projects recommended by the mission to address issues in the subject area.

#### 3.2 Eleven Subject Area Classification Scheme

Numerous classification schemes could have been adopted. In fact, the team moved from 18 to 12 and then to these final 11. The important point is that the subject areas, while not perfectly discrete, facilitate the ordering of the mission's observations, capacities and recommendations. Therefore, the subject areas had to be comprehensive and simple, even if somewhat overlapping.

Inland water transport, while itself a system, is part of a broader context of water resources development. Figure 3.1 describes how IWT systems, as classified into the eleven subject areas, fit into this broader picture. The solid boxes in the figure correspond to these areas.

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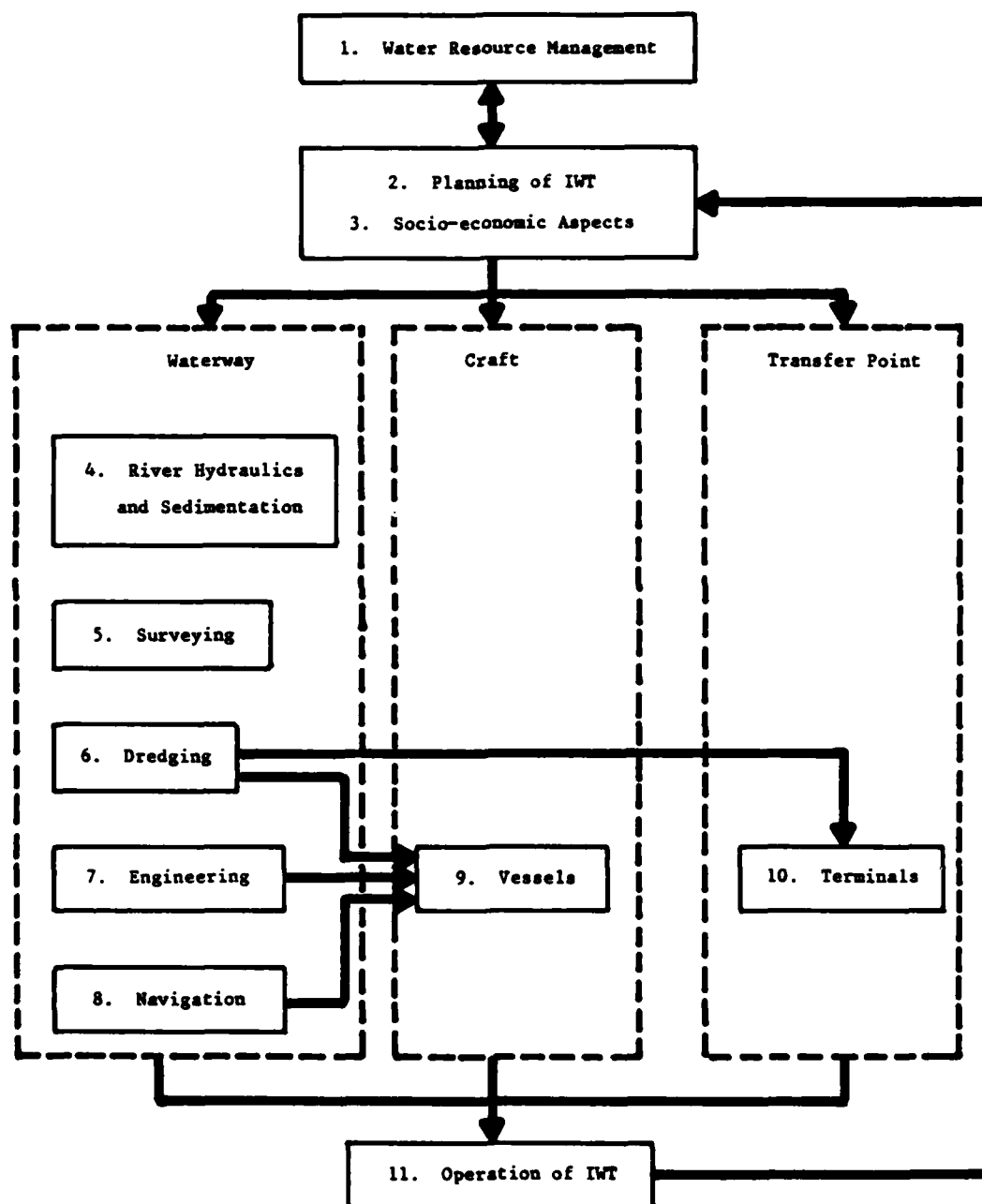


Fig. 3.1 Relationships Among the Eleven Subject Areas

Briefly, the figure shows that the principal elements of IWT are the waterway as a means of transport, the craft which move in the waterway and the transfer points on the waterway. These elements are represented by the dotted line boxes. IWT subject areas of hydraulics and sedimentation, surveying, dredging, engineering, navigation vessels and terminals can be usefully seen as falling within these elements. However, the planning and ultimate operations of IWT systems also depend on the other uses of water, signified by the solid box labelled water management. These other uses of water are normally related to IWT through planning and socio/economic assessment of various multiple use alternative shown in another solid box. Ultimately, the operation of IWT, as labelled in the bottom box, depends on how water resource management decisions are made after the planning and socio-economic assessment. Therefore, while the mission focussed on those immediate IWT subject areas within the dotted lines, members felt strongly that the mission could not ignore those subject areas shown in the figure as solid boxes, outside the immediate IWT subject areas. The following paragraph explains this diagram and concept in more detail.

Context of IWT: The context of IWT is captured in the following three subject areas which appear as solid boxes outside the immediate IWT system appearing as dotted boxes.

1. Water Resource Management This subject area considers the multi-use nature of water resources ranging from irrigation through hydro-electric power to IWT. This multi-use aspect requires that a global view be taken of the water resource. The main characteristic of the subject area is the comprehensive aspect required for master planning, river basin planning and water resources management;
2. Planning of IWT This subject area considers the planning of the nature and extent of the IWT sector. However, this planning is iterative in water resource management and requires inputs and feedback from all of the other IWT subject areas. The main difference with subject area one is that, here, the various elements of management and planning are treated independently;
3. Socio-economic Aspects This subject area considers factors beyond the direct financial impacts. IWT will also have various social impacts, including the provision of transport facilities to areas now poorly served and the generation of employment.

#### Immediate IWT System

The IWT subject areas used by the mission can be conveniently separated into the aspects concerned with the waterway itself; the means of transporting goods and people along the waterway called craft or vessels; and, the interface between the craft and other modes of transport called the transfer point or terminal. Each of these three areas is considered in turn.

The Waterway includes the following subject areas:

4. River Hydraulics and Sediments This subject area deals with physics of the waterway, water and sediment motion, hydrology, morphological processes or, in other words, the physics behind alluvial river problems. It also deals with physics behind, effectiveness of river training, impact of structures on the river, dredging methods and low cost dredging alternatives. The methodology of research and research tools, such as mathematical and physical modeling, is included.
5. Surveying This subject area is concerned with the collection of hydraulic and sedimentation data and the required equipment and trained staff available to undertake required measurements.
6. Dredging This subject area is concerned with the maintenance of a waterway — usually an expensive item. In this area, due attention should be paid to the selection of the appropriate equipment. The actual operation should be well planned and managed. In some cases, low cost dredging technologies may be appropriate. Further investigation into the areas where they may be applied is also considered within this subject area.
7. Engineering This subject area is concerned with civil and hydraulic structures associated with the waterway (excluding terminals — which are included in subject area "Terminals, ports and harbours").
8. Navigation In order to assist the safe navigation of the craft using the waterway, it is essential that the mariner has adequate information. This subject area is concerned with the provision of aids to navigation and navigational information including vessel handling characteristics in narrow channels or the interaction between craft and waterways.

Craft includes one broad subject area:

9. Vessels This subject area considers the appropriate type, design and powering of IWT and IWT/coastal vessels.

Transfer Point also includes one subject area:

10. Terminals This subject area concerns the design and layout of IWT terminals. Often this requires a number of unique features to be incorporated. Probably the most important of these are the large seasonal changes in water levels. Consequently, the appropriate design and layout needs careful consideration.

#### Operations

After planning and constructing the waterway, craft and terminals each system requires to be operated.

11. Operation of IWT This subject area includes the efficient operation of all IWT activities. This requires that the relevant staff receive exposure to systems which are operated elsewhere and adequate and appropriate education and training. This subject area is also concerned with how operations link back to the overall plan of IWT transport.

In summary, when examining IWT we are dealing with a total water resource system. Consequently all IWT subject areas used by the mission are related. Figure 3.1 attempts to describe these relations. Once again, the subject areas themselves are simply one attempt to capture the main features of IWT.

### 3.3 Review of Issues, Capacity and Recommended Projects by Eleven Subject Areas

China is a special case. IWT development there is somewhere between the rest of the region and US/Europe. China's IWT target is to bridge the gap between China and US/Europe. This should be considered carefully before implementing the recommended projects. A clear picture of the IWT issues in the Philippines, was not obtained. The observations and discussion there were limited to the Pasig River, (see paragraph 2.8).

#### 3.3.1 Water Management

##### a) Review of Observations of IWT issues and problems

For nearly all rivers visited and discussed there is an absence of the total picture of the river and the multi-use of the water or waterways. Water management and master planning are often not applied. Many organizational problems exist between users. For example:

- irrigation, flood control and hydropower are often each more powerful than IWT; and,
- countries and states often pursue conflicting or competing objectives;

Also, a number of problems in building water management models, exist. For examples:

- There is a lack of training;
- Little hardware and software is available; and,
- Little comprehensive interrelated data of the river basin, called 'far field' data in paragraph 3.3.5, exists.



Finally, there is only little awareness of some users of relations among users. For example:

- IWT as user is often not visible;
- barrage operations and IWT often are not related;
- a number of vessels such as country boats are not registered;
- power plants and thermal pollution along with water quality, fisheries, industrial and domestic water use are rarely related.

In the few cases where water management and master planning are applied, IWT is not considered to be a serious user.

b) Review of capacity of the region

The multi-use of the waterways in a river basin is generally not considered throughout the ESCAP region. IWT, often one of the major users, has a low priority. Comprehensive studies using systems analysis are generally not applied. Hence, capacity in the region to deal with water management studies and river basin planning is low.

c) Review of recommended projects

To improve knowledge on methods of water management and master planning in the region the mission proposed a project on:

- Comprehensive water management and master planning

To analyse present organizational constraints and to promote cooperation between the various users, the mission proposed a project on:

- Administration of water resources

Also a number of country specific applied studies with potentially high spin-offs for the region were proposed. They are:

- o Indus River, IWT feasibility study (Pakistan)
- o Irrawady River, IWT feasibility study (Burma)
- o Pasig River, multi-purpose study (Philippines)
- o Canalization of the Atrai-Jamuna and Karatoya rivers (Bangladesh)

### 3.3.2 Planning

(a) Review of Observations of IWT Issues and Problems

Throughout the ESCAP region, there is a clear need for data on the physical aspects of the waterway, including inventories of structures, the vessels, passenger and cargo flows.

There are difficulties in collecting data, and, in some cases, the most cost effective means of undertaking this is with sample surveys. Once the basic data is available, future uses and project proposals can be evaluated. In this way support in undertaking the planning process and in providing the techniques whereby the studies can be executed may be provided.

The two main areas of interest are the forecasting models and appraisal models. Within the forecasting models, an important aspect is the analysis of competing modes of transport, since in a number of countries competing modes are available.

In some countries, pricing systems exist for IWT facilities. However, the rationality of these systems is questionable. Similarly, freight rates are sometimes centrally administered and are subject to strong criticism. In many countries both inside and outside the ESCAP region, philosophy is changing in the direction of charging for the facilities provided by the IWT authorities. Consequently, these pricing aspects are becoming more important.

#### (b) Review of the Capacity of the Region

The planning of IWT is generally weak and in number of cases a long-term view does not exist. The IWT sector tends to be isolated from other sectors and consequently coordination is minimal or absent. Insufficient attention is paid to alternative means of transport and thus, whether IWT is competitive or can attract traffic is not fully considered.

Techno-economic or cost-benefit studies are rarely undertaken to justify planned investments, and trade-offs between, for example, the cost of installation of navigational aids on a vessel and the benefit derived from the improved navigation at night or during reduced visibility, have not been evaluated.

#### c) Review of Recommended Projects

The team members developed 12 projects to address these issues. Four projects are concerned with the collection of data. The first: Data collection and definitions for IWT in the ESCAP region calls for the establishment of a basic system of data collection with standard definitions, which in some cases may only require re-arranging of existing data. Because of the difficulty in collecting similar data, a Manual on statistical sampling techniques for IWT traffic is also proposed. The third data project proposes the collection, at a central place, of data and studies which have been undertaken on IWT. This project, titled Development of a learning resource centre in conjunction with the Palembang IWT Centre is country specific but its elements can be applied to other countries or to the region. The fourth project - National inventory of rivers serving IWT in the Philippines is also country specific.

One general impression of the mission is that IWT is the least visible of all transport modes. In order to increase its visibility and to gain some insight into its future, these studies are proposed; - The marketing

of IWT services: A study to define and market the IWT services; and IWT as a long-term domestic transport mode. These studies would use market survey techniques.

The mission proposes four central projects in planning; Transport Planning and IWT Forecasting, 13, 14, 15, 16 and the beginning of Appendix E, and A Manual on technico-economic analysis of IWT.

One of the physical models which assists in preparing project proposals and can be used directly in the technico-economic analysis is Water transport capacity models.

To deal with the complex issues of pricing in the region, two projects are proposed; - The pricing of IWT and associated facilities; and, The level and structure of IWT freight rates.

### 3.3.3 Socio/economic aspects of IWT

#### a) Review of observations of IWT issues and problems

Throughout the ESCAP region, IWT development was often said to be needed for socio/economic reasons. Many officials stated that IWT was an essential lifeline for transport of people and for small to mid-level commerce. Development of IWT was sought to stem the urban population concentrations by connecting smaller development centres together by water transport. In some cases, IWT was the only means of transport for resettled populations. Many officials expressed a need to improve the locations of terminals and to broaden IWT cost-benefit analyses. Despite the importance given to the socio/economic goals which officials set for it, IWT development was rarely mentioned in the national development plans of the countries visited. While country boats were, to varying degrees, observed to be important, statistics on their traffic are sparse and administration of country boat traffic weak. Finally, information about those appropriate technologies which have been developed and successfully used throughout the region are not effectively shared throughout the region.

#### b) Review of the capacity of the region

Most of the countries visited had some capacity to do social and economic analysis. However, this capacity is rarely used in support of IWT development. Therefore, the existing capacity has accumulated little experience with socio-economic analysis of IWT development.

#### c) Review of recommended projects

Mission members developed five projects to address these issues and capacities. They are:

- o A project for study of the socio-economic importance of country boats to produce techniques for evaluating country boat operation and for assessing the importance of country boats to the region.

- o A project for calculating locational and other socio-economic benefits to IWT development to produce a practical guide to such methods for officials throughout the region.
- o A project for the use of IWT to achieve other social and development goals to produce a review of this area; a guide for officials on how to use IWT to achieve social and national goals; and, an applied training course in social analysis techniques for IWT officials throughout the region.
- o A project for examining employment generation and impact of IWT in the ESCAP region to produce an assessment of IWT employment effects, a practical guide to methods for such assessment and the initiation of an IWT employment data-base for the region.
- o A project for examining the diffusion, social adoption and impacts of change in IWT technology to produce a review of how the theories of innovation and diffusion can be applied to IWT in this region; a technology assessment of the most likely changes in IWT; operations and vessel design; and a practical guide to officials on how to encourage diffusion and adoption of IWT innovation and appropriate technologies in the region.

#### 3.3.4 Hydraulics and Sediments

##### a) Review of observations of IWT issues and problems

Maintaining sufficient navigable depth in waterways is a major problem throughout the region. Besides financial problems, there are rather fundamental technical problems. For example, there is a lack of understanding of physics behind the siltation both in rivers and river mouths. This is probably due to a shortage of training, data and research. Consequently, difficulties arise in finding the best solutions and low cost methods to minimize maintenance. This is especially true in the many alluvial rivers in the region, where the meandering of the rivers causes additional problems such as bank erosion, varying location of shoals and channels and the need for remarking after each monsoon. The strong seasonal changes make seasonal maintenance necessary such as dredging after each monsoon.

##### b) Review of capacity of the region

Capabilities vary through the region from basic knowledge to very adequate. Transfer of knowledge among the countries of the ESCAP region will be fruitful.

The capabilities within the country are often not optimally used for the reasons indicated in section 3.3.1, on water management. IWT is an isolated sector. In general, hydraulics and sediments studies are not used for IWT. These studies are mainly applied to irrigation, flood control and/or hydropower analyses. The hydraulic institutes and IWT organizations generally belong to different ministries.

Often substantial capabilities exist to tackle hydraulics and sediment problems in the river mouth approach channels and port areas that cause sedimentation of harbour and approach channels. Therefore, coordination problems limit capabilities.

c) Review of recommended projects

The major regional projects proposed to deal with these issues are:

- A project to develop a methodology of tackling alluvial river problems with the aid of river models called "Training on alluvial river model building"
- A project on research on fundamentals of solving shoaling problems called "Advanced methods to solve shoaling problems"

The first project aims to spread the desired training through the region via workshops. The second project will focus on the physics behind both shoaling and the measures to reduce it. Its results will be described in a guide book to be circulated through the region. The section dealing with shoaling in alluvial rivers provides a link between both projects.

A number of projects, related to the second project, are grouped in other subject areas. They seek development of low cost measures against shoaling and are called:

- o Research on bandalling techniques,
- o Pile screen survey, and
- o Regional cooperation in low-cost dredging technology.

### 3.3.5 Surveying

a) Review of observations of IWT issues and problems

Surveying the rivers is often restricted to the river mouth, its main ports, visible benefits and engineering works. Engineering works usually involve data collection in the near field or in small sections of the river around the construction site; data collection of design of structures; and ad hoc surveys.

In general, systematic far field surveying, which is the monitoring of the whole waterway system, is not adequate and is rarely done. In fact, there is almost no comprehensive water management in the region (See 3.3.1). Consequently, survey equipment is often in limited supply and old. Such equipment is only modernized in conjunction with the design of big structures. Upgrading is desired in many cases.

Many organizational problems were observed. In some instances data collected by marine surveyors or port authorities in tidal reaches or at river mouths have not been made available to IWT authorities.

b) Review of capacity of the region

Throughout the region the capacity of surveying varies widely from non-existent to very adequate. Exchange of knowledge within the region is also desired.

The best capabilities are generally available in the river mouth which is overseen by hydrographic departments of harbour authorities. The spread of capabilities in an upstream direction is desired.

Capabilities are often limited by the amount and the quality of the equipment. This is especially true in the field of bathymetry where considerable production (i.e. chart making) is required, but the cost of automation of such equipment as digital echo sounder and electronic positioning is high.

c) Review of recommended projects

Since chart making is often a burden to many countries, a project on Nnavigation chart development is proposed. The project aims at setting up guidelines which describe methods of charting and development of equipment.

Moreover, a number of projects are proposed to support other projects and to outline special surveys related to maintaining the navigable depth and dealing with shoaling problems: The first project is a general one which outlines the methodology, including a case study. The last three projects are country specific but important for the region: They are:

- o Minimum navigable depth study (including survey)
- o Study of big shoal (south of Chandpur Bangladesh)
- o Pile screen survey (Burma)

3.3.6 Dredging Technology

a) Review of observations of IWT issues and problems

There is an overall lack of trained personnel in the dredging area for both dredge operations and equipment maintenance. In addition, there is a lack of management training, including project management and operational aspects, for management officials. The capability of the dredge fleets in the countries is inadequate to meet the requirements. Severe siltation occurs at all harbours and river mouths impacting the limited dredging capability and loading characteristics of vessels. This siltation problem also places a financial strain on management. There is a general use of improper disposal techniques for dredged material employed throughout the region, as well as a need to make better equipment selection for specific dredging requirements. Low cost dredging technology is being employed throughout the region but success and failure stories are not being shared to influence future actions.

b) Review of capacity of the region

The capability of most countries to dredge their major harbours is generally adequate, hampered only by funding inadequacies. The situation becomes progressively worse as river systems proceed inland. In the upper reaches of IWT systems, funding and equipment do not adequately exist to perform the necessary dredging. Experimentation is being sparsely done on alternatives to dredging with some positive results. Technology transfer in the form of dredge selection, alternative selection, and fleet management needs to be improved among the countries.

c) Review of recommended projects

The mission developed the following projects to deal with its observations about dredging in the region.

- A project on regional cooperation in low cost dredging technology;
- A study to determine the best investment strategy for operation and maintenance;
- A study to develop a comprehensive dredging plan;
- Introduction of dustpan dredges into Asia;
- Research on bandalling techniques.

These projects will have the following effects: The overall level of trained personnel in the region will be increased, from the dredge crews, dredge maintenance and repair crews up to the project management personnel. Through the exchange of information on low cost dredging technology, the capability of the existing personnel and dredge fleets can be expanded without the purchase of more equipment. Increased production will lessen the overall shortfall in dredging requirements in the region. This increase of production should provide overall improvements in channel conditions by reducing the amount of siltation which is dredged each year; thereby increasing commodity movement and reducing financial strain on management for more money and equipment. The employment of proper disposal procedures will reduce the overall dredging quantities on an annual basis, enhancing navigability and reducing total annual dredging costs. The combination of proper dredging practices and the employment of alternatives to dredging (i.e. sediment control structure, bandalling) will reduce the overall dredging requirement. The introduction of new types of dredgers, such as the dustpan, could have a resounding effect on the production of dredgers, enhancement of performance and lessening of the overall requirements for personnel and equipment.

### 3.3.7 Engineering Issues

a) Review of observations of IWT issues and problems

Engineering issues are primarily concentrated on the following areas:  
(1) inadequate bridge clearance requirements for safe boat passage; (2) bank

erosion, (3) existing structures obstructing the development of navigation, and (4) lack of knowledge in low cost structures for river training. China has a special problem relating to ice, which restricts the flow of traffic during part of the year.

b) Review of capacity of the region

Capabilities vary from baseline knowledge to adequate. In some countries of the region, knowledge of design and construction of weirs, locks, bank protection, is available. The exchange of this knowledge seems promising.

However, most engineering is focussed on hydropower and irrigation structures such as dams, barrages inlet sluices. At the same time knowledge of structures for IWT is lagging (see terminals).

Exchange and further development of knowledge on low cost structures for river training and bandalling is recommended.

c) Review of recommended projects

The following projects have been recommended to deal with these issues:

- Guide to remodelling old bridges
- Design of still water canals
- Guide to adapt canals to IWT
- Model testing of training structure
- Standard design of bank erosion structure

Engineering requirements in the region generally exceed the capabilities of the region. The recommended projects will fulfill much of this deficiency and will provide a more efficient operation of the IWT system. The ice problem in China is country specific and a study would not have regionwide application.

### 3.3.8 Navigation Issues

a) Review of observations of IWT issues and problems

Navigation issues vary throughout the region and cover items such as inadequate aids to navigation, strong tides making navigation possible only during certain periods, lack of adequate traffic control and removal of wrecks and snags.

b) Review of capacity of the region

Experiences vary throughout the region, hence exchange seems fruitful. Training possibilities are often poor. Aids to navigation are often poor; information for mariners is generally not available. Additional problems are encountered in the transfer areas such as from IWT's to sea-going transport.



c) Review of recommended projects

The following projects have been recommended to deal with these issues:

- Aids to Navigation;
- Navigational information; and
- Guide to debris control

Navigation issues far exceed the navigation capabilities of the region. These recommended projects will significantly contribute to the knowledge and safe navigation of the region. Issues on traffic control will be enhanced as will strict enforcement of their existing rules and regulations.

3.3.9 Vessel Issues

a) Review of observations of IWT issues and problems

Issues relating to vessels center on the quality of the present fleet and the need for improvements and new design to increase the efficiency of their operations.

b) Review of capacity in the region

The quality of the fleet varies widely in the region. Exchange of knowledge on type, selection and design is recommended. However, in many countries the country boats are still constructed in a traditional way. Also for these vessels, improvements in sail design, method of rowing and hull shape are possible. Capability of fleet operation can be improved.

c) Review of recommended projects

The following recommended projects deal with these issues and observations:

- Inventory of existing types of country boats and analysis of their traffic flow;
- Low cost repair yards for country boats;
- Optimization of design of country boats including modernization of existing fleet;
- Introduction of long-tail boats throughout region
- Benefit analysis of the introduction of radar to IWT vessels;
- Conversion of barges for push towing, and
- Development of vessel design for people transport on waterways

The vessel issues which surfaced during the mission far exceed the capabilities in this area. The recommended projects will help the region deal with these issues and will provide the information needed to optimize the design and operation of vessels throughout the region.

### 3.3.10 Terminals, Ports and Harbors

#### a) Review of observations of IWT issues and problems

All inland river ports are impacted by inefficiency in cargo handling due to large variation in water levels. The more severely impacted ports are in Indonesia and China. Port operations are also hindered by inadequate operational and storage space as well as limited amounts of mechanized equipment for cargo handling. Throughout the region, the inland river ports are the weak link in the IWT chain. There are uniform inadequacies in the number of inland river terminals and a general lack of portable or movable jetties. The poor design and layout of port and river terminals contribute significantly to the congestion and delays which hamper efficient port and vessel operations. The significant number of country boats in the region warrants consideration of special terminal space at major ports and increased emphasis on major river terminals for country boats. Throughout the region it holds that major port authorities and IWT organizations are separate organizations under separate ministries. Overall coordination is lacking and is needed for the smooth transition from coastal to inland transport.

#### b) Review of capacity of the region

In general, seaports are more developed than inland ports. In their development and maintenance, hydraulic and sediment studies are applied, proper terminals are constructed and adequate maintenance dredging practices are employed. Sea ports do, however, lack the capacity to accommodate country boats at their terminal facilities. The capability to construct river terminals is generally adequate in the region, however, the design capability is often lacking, particularly in rivers with large water level variations. There are few terminals on the upper reaches of IWT systems. The handling system is also very limited. Few records are kept on vessel and commodity movement between terminals.

#### c) Review of recommended projects

The following projects dealing with terminals, ports and harbours are recommended:

- Commercial traffic between ports
- Modification of deep sea ports, to include accommodating commodity transfer to country boats
- Standard design and operations of inland waterway facilities
- Design and layout of IWT ports, including separate docks for country boats

- Develop proper means to introduce containers, including proper sizing analysis
- Design of terminals for special conditions
- Planned maintenance of IWT terminals.

The projects will have the following effects: The identification of vessel and commodity flow between terminals will better define the facility requirements at terminals. The projects will identify features of deep sea ports which need modification in order to accommodate inland transport vessels, including country boats. The development of standard design for inland waterway terminals; both permanent and portable will be improved. Terminal operations will be enhanced through the introduction of container and mechanized handling equipment where feasible. Development of special port terminal design for critical conditions such as large water level fluctuations and movable terminals will be improved. Maintenance plans for port and terminal facilities will be established.

### 3.3.11 Operations

#### a) Review of observations of IWT issues and problems

A number of factors, including the low visibility of IWT and its low priority among other water uses, have influenced the level of resources available to the sector. Consequently, the numbers of qualified staff are relatively small. It has also meant that funds have not been available for staff to become aware of the techniques and technologies available elsewhere.

In a number of countries, IWT had been non-existent or neglected for a long period thus creating a shortage of skilled staff and knowledge of available technologies.

While these observations apply to all aspects of the operations of waterways, terminals and vessels, experience varies between countries.

#### b) Review of capacity of the region

The operation of IWT and its associated facilities throughout the region is variable. That is, some countries appear to have a reasonably well run operation, while in others, sometimes as a result of lack of funds, the operation is not as efficient as it could be. In some cases, this is a coordination problem among the various bodies and authorities concerned with the waterway. For example, many countries have separate dredging companies for irrigation and navigation. Also, in a number of countries, there is no capability in specific areas due to the non-existence or neglect of IWT.

#### c) Review of recommended projects

The mission believes that the solutions to the problems and issues discussed above are mainly to be found in assistance in implementing modern management, administrative and operational techniques. This means exposing

the relevant IWT staffs to systems operated in other countries, within the ESCAP region as well as outside. It also means providing appropriate education and training to those IWT staffs. The following recommended projects reflect these views.

Given the time schedule of the team, it was not possible to identify specific areas where management training is required. Such identification would require a deeper analysis of the actual operation; consequently, Management of IWT activities is a project aimed at identifying the areas of need in IWT management. This is followed by five general projects which broadly reflect complementary means of transferring knowledge - Port management training programme, Series of IWT audio visuals, Training for trainers for IWT in the region, "In-service" training and Regional study tour programme.

The remaining four projects are concerned with the dissemination of information and technology. The project IWT information system is concerned with establishing either direct information links or bilateral links with counterpart organizations in the US and/or Europe. Technology transfer of selected indigenous IWT appropriate technologies and innovations among countries in the ESCAP region is primarily concerned with training the persons involved in technology transfer using specific regional examples. Other vehicles for information transfer are contained in the projects Develop a quarterly IWT journal, a Yearly meeting of key IWT officials in the ESCAP area and an Immediate 2-Day Seminar for IWT officials in potential donor organizations.

The project Customs procedures and IWT is an operational aspect over which a number of countries expressed concern.

CHAPTER 4

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## RECOMMENDED IWT PROJECTS TO DEAL WITH OBSERVATIONS AND ISSUES TO ENHANCE IWT CAPABILITY THROUGHOUT THE REGION

### 4.1 Introduction

The mission identified 71 projects, which, if accomplished over the next ten years, would enhance IWT capability and visibility throughout the region. The background, objectives, descriptions, outputs, approaches and scopes of these projects are fully documented in Appendix E.

Projects which are either regional, or country specific with regional significance, are included. By regional, the mission means projects which are important to more than one country even if the project focuses primarily on one country. As directed by ESCAP, the mission was oriented to such regional projects. However, the mission members also recognize that regional projects are frequently more difficult to fund than country specific projects.

### 4.2 Recommended Project Classification

All of the following projects are recommended projects. From the almost limitless possible projects, the mission, after much discussion, feels that these 71 projects form the basis of a 10-year IWT programme for ESCAP, an IWT center, or some other special IWT programme. However, the mission members are also realistic and realize that budget constraints and other factors could limit the UN system's capacity to implement these projects, despite the strong endorsement given to them by the mission. Therefore, the mission has divided the 71 projects into three further categories: critical, highly important and important.

To place projects into the critical and highly important categories, the mission members collectively asked the following questions of each of the 71 projects:

- o Is the project an essential foundation study for further work?
- o How implementable is the project? (Is it practical, fundable and technically flexible?)
- o How visible will the completed project be throughout the region?
- o What are the projects benefits versus its costs?
- o What is the man/month impact versus importance?
- o What is the extent of the project's need and use versus its cost?
- o Are the projects reasonably distributed across countries of the ESCAP region?
- o What is the capacity of the project to facilitate transfer of appropriate technologies throughout the region?

- o What is the priority of the project in the effected countries?
- o Are these projects reasonably distributed across the 11 major IWT subject areas?

The 70 projects are listed, numbered and grouped into these three categories as follows:

A) Critical [8]

- o "Training of Trainers" for IWT in the region (63).
- o Series of IWT audio-visuals (62).
- o Technology transfer of selected indigenous IWT appropriate technologies and innovations among countries in ESCAP region (68).
- o Regional cooperation in low-cost dredging technology (33).
- o The socio-economic importance of country boats (22).
- o Employment generation and impact of IWT in ESCAP region (25).
- o The marketing of IWT services (11).
- o Develop a quarterly IWT journal (69).

B) Highly Important [16]

- o Advanced Methods to Solve Shoaling problems. (Guidebook) (28)
- o Research in Bandalling Techniques. (37)
- o Indus River Feasibility Study. (3)
- o Design of Still Water Canals. (39)
- o Comprehensive Water Management Plan. (1)
- o Regional Study Tour Program. (65)
- o Minimum Navigable Depth Study (to include surveys). (30)
- o Introduction of Dust Pan Dredges in Asia. (36)
- o Inventory of existing types of country boats and analysis of their traffic flow. (46)
- o Conversion of barges for push-tow. (50)
- o The use of IWT to achieve other social/national development goals. (24)

- o Administration of water resources. (2)
- o Transport Planning and IWT; including traffic generations and commodity analysis (13)
- o Manual on technical/economic analysis of IWT. (17)
- o An immediate two-day seminar for Asian Development Bank, World Bank and other selected potential donors to describe the study and to build an action program. (71)
- o Yearly meeting of key IWT officials in the ESCAP region. (70)

C) Important [45]

- o Guide to remodelling old bridges. (38)
- o Guide to adapt canals to IWT. (40)
- o Model testing of training structure. (41)
- o Canalization of Atrai-Jamuna and Karatoya Rivers. (6)
- o Pasig River multi-purpose study. (5)
- o Irrawady River feasibility study. (4)
- o Standard design of bank erosion structures. (42)
- o Aids to navigation. (43)
- o Navigational information. (44)
- o National inventory of rivers serving IWT in the Philippines. (10)
- o Commercial traffic between ports. (53)
- o Modification of deep sea ports, to include accommodating commodity transfer to IWT craft and country boats. (54)
- o Port management training program. (61)
- o IWT information network. (67)
- o In service training. (64)
- o The marketing of IWT services. (11)
- o Study of big shoal (South of Chandpur, Bangladesh). (31)



- o Pile screen survey. (32)
- o Navigation chart development. (29)
- o Study to determine best investment-strategy for operation and maintenance. (34)
- o A study to develop a comprehensive dredging plan. (35)
- o Low cost repair yards for country boats. (47)
- o Optimization of design of country boats including modernization of existing fleet. (48)
- o Introduction of long tail boats throughout the region. (52)
- o Benefit analysis of the introduction of radar to IWT vessels. (51)
- o Design and layout of IWT ports, including separate docks for country boats. (56)
- o Development of vessel designs for people transportation on waterways. (49)
- o Development of proper means to introduce containers, including proper sizing analysis. (57)
- o Planned maintenance of IWT terminals. (59)
- o Calculating locational and other socio/economic benefits to IWT development. (23)
- o The diffusion, social adoption and impacts of changes in IWT technology. (26)
- o Management of IWT activities. (60)
- o The pricing of IWT and associated facilities. (19)
- o The level and structure of IWT freight rates. (20)
- o Customs procedures and IWT. (66)
- o Manual on statistical sampling techniques for IWT traffic. (8)
- o Guide to debris control. (45)
- o Traffic distribution. (14)
- o Develop an IWT learning resources centre (LRC) in conjunction with Palembang IWT Training Centre. (9)

- o Data collection and definitions for IWT in the ESCAP region.  
(7)
- o IWT as a long-term domestic transport mode. (18)
- o Water transport capacity models. (21)
- o Training on alluvial river model building. (27)
- o Standard design and operation of inland waterway facilities.  
(55)
- o Design of terminals for special conditions. (58)

CHAPTER 5

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## 5 ELABORATION OF THE RECOMMENDATION FOR AN INLAND WATERWAYS TRANSPORT (IWT) CENTRE

### 5.1 Rationale for a Regional IWT Centre

Many of the observations and issues documented in Chapters 2 and 3 have independently been identified by the previous ESCAP mission. Since this mission visited more countries and interviewed more IWT officials, additional IWT problems have surfaced. Nevertheless, the mission members feel that progress in raising IWT awareness and skill throughout the region and among donors has been slow. First priority should be placed on achieving the projects outlined in Chapter 4. Any consideration of establishing a Centre should not delay or hinder the undertaking of these recommended projects. Progress should be accelerated by ESCAP, UNDP and other responsible regional parties. This mission reaffirms and restates a basic conclusion of previous missions: Some type of IWT Centre should be established within the ESCAP region. A Centre will be the best way to accomplish all 71 projects outlined in Chapter 4 and described in Appendix E.

Members of the 1985 ESCAP-IWT mission feel that an IWT Centre is needed to:

- pool IWT resources which are in short supply throughout the region;
- provide new visibility for IWT throughout the region;
- raise awareness within donor organizations of IWT's importance;
- legitimize IWT as an infrastructure investment;
- supplement and help donors examine the "best" IWT investment strategy;
- develop a regional IWT enterprise which can assist donors and funders and which can also supplement their staffs;
- share IWT experiences: successes and failures;
- identify individual country and regional IWT needs;
- provide and enhance available IWT training;
- facilitate transfer of "appropriate" IWT technology among countries within the ESCAP region;
- facilitate cooperation among governments; first on IWT and then perhaps greater cooperation in other areas;
- assimilate, interpret and disseminate IWT findings from worldwide studies throughout the ESCAP region;
- help write IWT project documentation for countries seeking funds for IWT investment;
- coordinate with other centres of IWT expertise such as DELFT, Waterway experiment station (WES), Water Resource Support Center (WRSC);
- analyze major port organizations and operations;
- develop and disseminate low-cost dredging technology.

### 5.2 Functions of a Regional IWT Centre

An IWT Centre should include research, applied studies, training, field assistance and technology transfer functions. It should carry out these functions through activities such as:

- assisting donor agencies to prepare project documentation;
- convening special workshops and seminars to identify needs and to assess problems and to share IWT experiences;
- developing and sponsoring IWT training, including programs designed to "train the trainers" and programs to enhance IWT management skills;
- assisting countries to collect and to process IWT data and information;
- designing and developing a regional IWT data base and information system which can be used by all countries in the ESCAP region;
- organizing and executing research and applied studies to find solutions to IWT problems;
- organizing field programs to provide site specific assistance;
- networking among major centres of IWT expertise world-wide;
- maintaining a list of and facilitating the use of world-wide experts in various IWT areas.

While there are other institutions in the ESCAP region which are capable of performing one, a few, or part of these functions, no one institution or country now possesses the capacity to perform most of these functions. Furthermore, coordination among the various centres of expertise must be vastly improved. But even with improved coordination, the region still lacks much of the needed IWT capability.

### 5.3 Organization and Funding of an IWT Centre

An IWT Centre should be funded through a combination of UNDP funds, donor country services and host country facilities and services. UNDP should guarantee sufficient funds to complete initial start-up and operation, most likely the first 5-7 years. After this period the centre should become basically self-financing. Funding can and probably would be supplemented by loans of professionals from nations experienced in IWT along with contributions of services and facilities from countries within the region.

The mission identified two viable alternatives for organizing an IWT Centre. Alternative One is to create a major, full scale and self-contained Centre of IWT expertise for the region. If such a full Centre is adopted, the project work would be accomplished through a mix of "in-house" and outside consultations. Alternative Two is to undertake a more modest approach of a highly mobile core staff and the means to bring in more outside experts on a project-by-project basis. This alternative would achieve some, but not all, of the goals already stated. However, it would be a step in the right direction. Both alternatives are described in the following paragraphs.

If neither alternative is adopted, the mission recommends that ESCAP undertake those projects listed in Chapter 4 and documented in Appendix E. Also, in this case the projects should be undertaken in accord with projects priorities established in Chapter 4.

#### 5.3.1 Alternative One: A full-scale IWT Centre of Expertise

Figure 5.1 shows a basic organization for a full-scale Centre. The following discussion follows this figure. Two special advisory boards should be initiated by ESCAP/UNDP to oversee the Centre's work. First, a Technical

Advisory Board should be established. It would include 7 members, each of whom would be an IWT expert. Half of the members of this board should be from within the ESCAP region and the other half should be eminent experts from outside the region. The Technical Advisory Board should meet once a year for 2-3 days. The meeting will first review the proposed technical content of the upcoming year and suggest changes. Second, the meeting will evaluate and provide written critique of the previous year's performance to the Centre's Director. Members of this board will be allowed to serve no more than two contiguous terms and terms of each member should be staggered. A term shall be for two fiscal years. ESCAP should solicit nominations for this board from among world-wide experts and institutions. Approval of the board will be by ESCAP. Members will be reimbursed travel, per diem and daily honorarium fees for service.

The Centre's second board should be a Governing Board. It would function to overview the policy implications and needs of the Centre's work. Like the Technical Advisory Board, a board member's term should be two years with members limited to two contiguous terms. The board should include 9 members chosen from countries within the ESCAP region, with representation from the UNDP. The positions should be fixed and ESCAP should generally accept the nominations of the organizations they are to represent.

This board should meet a minimum of once a year to review the general state of the centre and its relationship to policy issues throughout the region. However, the board could also be called into session by its Chairman, the Centre Director or the Executive Secretary of ESCAP. Reimbursements should be on the same basis as the technical advisory board.

Both boards should maintain strict attendance requirements. Administrative support for both boards should be provided by the Centre staff. Likewise, travel and reimbursement funds for members of both boards should come from Centre funds.

A full-scale Centre should include about 18-20 professionals distributed as Figure 5.1 shows. Most of the Centre's work will be accomplished by in-house Centre staff. The rest will be achieved through contract. While the Centre will maintain relations with other "in-place" facilities, it will also develop its own expertise where needed.

The Director should be an expatriate expert, perhaps on long-term loan from a country outside the ESCAP region. He or she should be appointed by the Executive Secretary of ESCAP with the advise and consent of the Centre's governing board. The Assistant Director should be appointed by ESCAP Executive Secretary with advise and consent of the Governing Board.

As Figure 5.1 shows, the training and field assistance branches should include one chief each and 1 or 2 assistants. Professionals of the R&D/Applied studies section will spend 40 percent of their time in either, or both, of the training and field assistance activities. The chiefs and assistants in the training and field assistance branches will be responsible for programming their respective branch activities and for assuring the completion of work. Also, those chiefs will be expected to provide 25 percent

# A Full-Scale IWT Centre

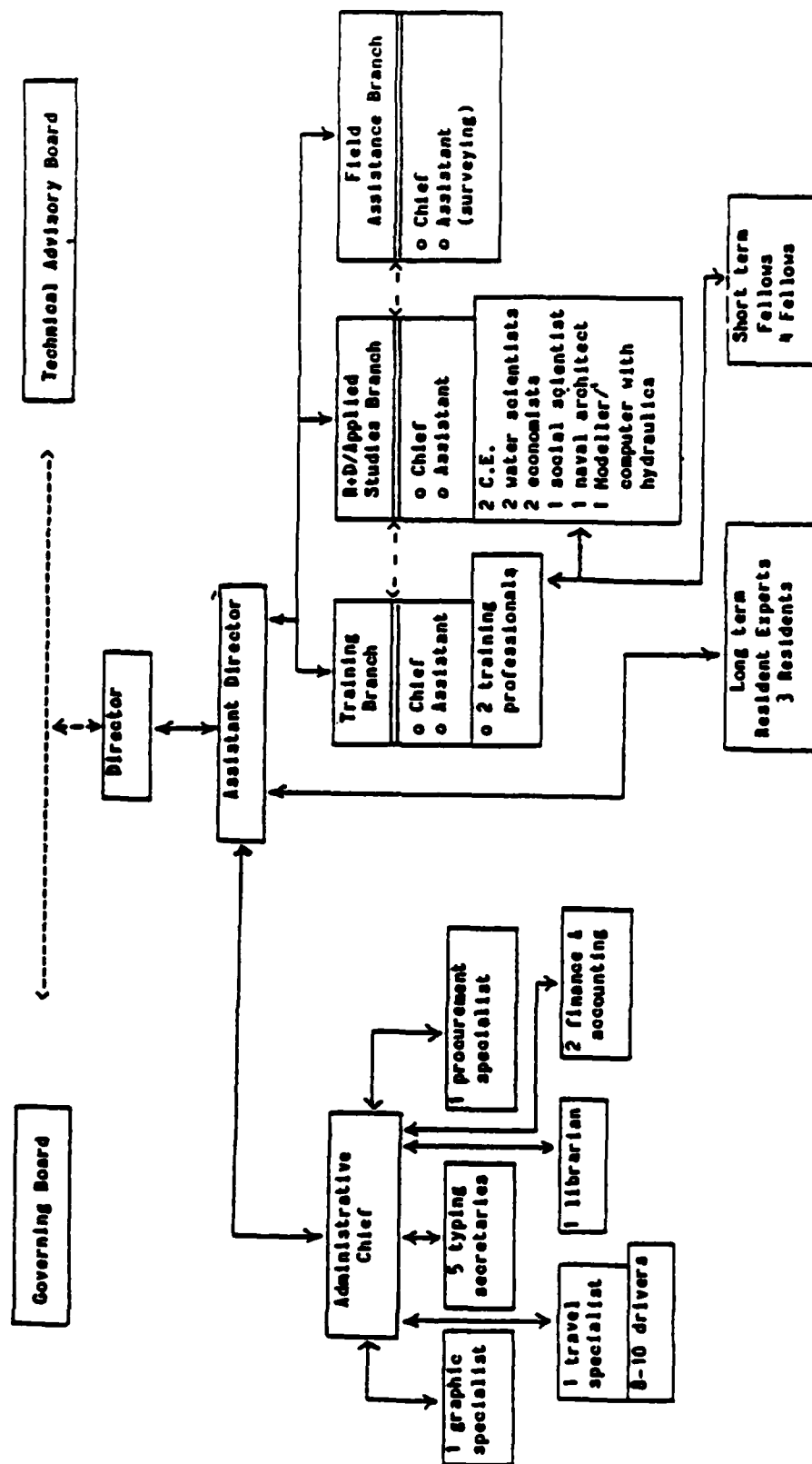


Figure 5.1

of their professional time to activities of other branches. Their assistants will be expected to provide 40 percent of their time to activities in other branches.

As a result, the professional work of the Centre will run on a matrix management principle. The Assistant Director will be responsible for the monitoring, fund allocating and timesharing of this matrix management system. The Assistant Director will require special management training and certification. All professional staff members will be required to have interdisciplinary team management training. Periodic team building sessions will be required each year. As new staff is hired, they will be required to attend the Centre's interdisciplinary Team Management course.

Administrative support for the Centre will require one graphics and reproduction specialist, with perhaps one assistant. One travel specialist, with perhaps one assistant, will be required to manage travel arrangements for the professional staff and the centre's cars and drivers. A procurement specialist and a librarian, together with two finance and accounting personnel, complete the administrative support. One of the finance and accounting personnel could "off-load" the procurement specialist during busy periods. Actual report production and legal consultation should be provided on a long-term contract basis.

Beyond the professional and administrative staff, the Centre will also house a long-term resident expert programme and a short-term fellowship programme. At any given time, the Centre should include 1-3 experts in residence. Most likely these will be IWT professionals from outside the ESCAP region who will frequently be supported by funds from their home country. However, experts from within the ESCAP region will not be precluded from serving as resident experts as supported by center funds. Their function will be to assist the "on-line" Centre programme, first, and second, to complete personnel research. Experts should reside at the centre for 1-2 years.

The short-term fellowship programme will be designed for younger graduate level students who are working at the Masters or doctorate Level. Like resident experts, many could be supported by funds from their home country outside the ESCAP region. Others from within the ESCAP would be supported by Centre funds. However, the priority in this programme will be to recruit students from within the ESCAP region who are close to finishing graduate work and preparing to pursue careers in some aspect of IWT within the ESCAP region. It is expected that a short-term fellow will reside at the Centre from 6-12 months. At any given time there should be between 1-4 fellows.

As Figure 5.1 depicts, the resident experts, as fits their senior status, report directly to the Assistant Director and Director. The short-term fellows will be supervised by the appropriate professional in the R&D/Applied Studies Division.

The Centre would require 3 to 3.5 million dollars per year, exclusive of costs for physical plant procurement and operations. Roughly 2 million dollars would be allocated to professional staff. Three hundred and fifty to five hundred thousand dollars would be required by the administrative staff.



The special expert and fellows programmes should require around 350,000 dollars. Typing support should require between 150,000 and 200,000 dollars per year. Travel and communication are roughly estimated to be 300,000 dollars per year, including local travel. Appendix F provides more detail on the rationale for these estimated.

In addition to these manpower requirements the Centre would also require physical plant and equipment. To begin with, the Centre should be located in an area with minimal outside noise, comfortable surroundings and easy access to adequate permanent and temporary housing. It would require 20 separate offices for professional staff and seven separate offices for the resident experts and fellows. Four additional offices would be required for the administrative staff along with appropriate space for typing and secretaries. Drivers would need rest quarters and a common room.

Beyond space for specific people, the Centre would require two conference rooms, each capable of comfortably accommodating 30 people. These rooms could double as seminar or workshop rooms. Each should be suitably equipped. This means they should include at least the following: adequate seating and table space, overhead projector, slide projector, T.V. monitor and VCR, two easels and flip charts and walls that double as pin-board. Also, all offices would need suitable equipment such as desks, chairs, bookshelves, lights and telephones.

The Centre should also include the following rooms: a common room or lounge for informal meeting; a computer or data room to house one P.C. with a mainframe "tie-in" and software; a library room suitable for a modest IWT collection and able to seat about 20 people; a graphics room equipped to complete report layouts and briefings; a mail room to hold and sort mail, and Telex machine; a utility room; and, a photocopy room with up-to-date equipment.

Beyond these facilities, the Centre should also include 6 IBM P.C.s -- one for each division, one for the administrative support section; one for the executive office and one for common use in the computer room. All P.C.s should have capability to tie into a mainframe. Finally, the Centre typing should build on a central word processing system which ties together all typists.

#### 5.3.2      Alternative Two: A Small-Scale Approach of a Highly Mobile Core Group of IWT Experts

A smaller scale approach could be initiated by ESCAP. It would not achieve as much over the next 10 years as the full-scale approach. Nevertheless, a small-scale approach, properly designed, could achieve enough significant actions during the next 10 years to warrant consideration.

The basic philosophy of the small-scale approach is to maintain a small core staff which is highly mobile and which manages a large amount of work done by contract or visiting experts. The mission estimates that such an approach would require 3 professionals and 2 administrative support personnel to achieve enough actions to warrant its existence. It would rely on either a

host country or host organization for support services such as: libraries, computers, drivers, procurement and contracting, personnel administration, typing and other administrative functions.

The potential disadvantage in this approach is that it would always be a residual priority to those who administer its needed support functions. Therefore, an explicit contract with the support organization, reviewed yearly, would be necessary.

The professionals would include a director and assistant who should be IWT generalists. One of them should have design experience and the other conversant with the Socio/Economic aspects of IWT. They should be professionals capable of effectively spanning a range of disciplines associated with IWT. The third professional should also be knowledgeable about IWT. However, he or she should have a special competence in training adult education and technology transfer techniques. This is required because they would run numerous special seminars and workshops and training programmes. The two administrative support personnel would liaise with host country support services and perform typing. The total cost per year of such an approach, exclusive of physical plant procurement and operations, should be about 1.5 million dollars per year.

The professional staff would function to: select projects; manage experts; control product quality; facilitate result dissemination; maintain close liaison with IWT authorities throughout the region; organize and manage special training and seminars.

This small scale approach would require office spaces for professional and administrative staff. It should also have one conference room, a mail room and a utility room. The small-scale Center should have access to two conference rooms. All rooms should be equipped similarly to those described in Alternative One. In addition, a small-scale approach would require two IBM P.C.s with mainframe connection and word processing for the administrative staff.

#### 5.4 Comparison of Alternatives One and Two

While alternative Two would also increase IWT visibility throughout the region, it would dramatically reduce the extent to which within-region IWT capability is likely to be developed. Alternative Two shifts philosophy from in-house expertise to coordinating and contracting outside experts. With the increased reliance on outside experts and contracting, and the small number of people, both the number and type of IWT actions which would be undertaken over the next 10 years will change. A small-scale approach would be able to act in a less autonomous way than the large Centre. It would require close links to a parent organization such as a regional university or SPIW/ESCAP itself.

A full-scale Centre could complete most or all of the 71 recommended projects over the next 10 years. A small-scale approach will not be able to complete all 71 recommended projects. However, the mission members feel that a small-scale approach could complete the 9 critical and 18 highly important recommended projects, along with a small percentage of the remaining

recommended projects. If neither a Centre nor a small-scale approach is adopted, the mission recommends that ESCAP takes on, at least, the critical and highly important recommended projects.

#### 5.5 Generic Problems with Establishing Regional Centres

The following generic issues are important to consider before establishing any type of regional Centre. They are also important in the case of an IWT Centre and should be addressed by appropriate authorities.

Much of the information needed to achieve recommended projects for IWT has often been considered as propriety by ESCAP region countries. So the impact of such reactions on a Centre which has as one objective the sharing of such information, must be assessed and a strategy to deal with the issue developed.

The regional identity of the Centre is dependent on the relationship between the Centre, the host country and member countries. To be effective in the long run, any Centre should be able to independently sustain a substantial portion of its operations.

Even the best organization and plan will fail if not sufficiently capitalized initially. However, mission team members were left with the impression that funding must come exclusively from projects. While such funding arrangements could possibly work, they are far less desirable than a clear initial procedure for funding. Also, such arrangements could place excessive demands on projects and could compromise the quality of project output. So the sources and arrangements of funding are likely to affect the probability of a Centre's success, especially in its beginning stages.

Another indication of probable success and a key to the initial funding of the Centre are the likely users of its services. In successful cases, not all, but many of the potential users of a Centre's services should be visible and be willing to contribute financial or other significant support to a Centre. If such financial and other support is not forthcoming from countries in the region, strategy to either encourage the support or to mitigate its lack should be implemented.

#### 5.6 Special Concerns to be Addressed if a Centre is Located in Bangladesh

The establishment of a regional IWT Centre in Bangladesh was proposed at the ESCAP Commission at its 34th session in 1978 and reiterated in subsequent sessions. Two missions were undertaken in 1978 and 1980 to investigate the feasibility of setting up such a Centre in Bangladesh. To follow-up the recommendations of the Commission at its previous sessions, the present mission was requested to visit possible Centre facilities and interview relevant officials in Bangladesh. After these visits and interviews, the mission members concluded that the following issues should be addressed before locating an IWT Centre in Bangladesh.

Within the first two years of operation, a plan for long-term financing of a Centre should be developed. The relationship between a Regional Centre and Bangladesh's local IWT organization must be clarified. In-country support

staff would require a carefully designed and executed training programme to assure proper Centre operations. Also, a method should be established to manage pay scale differences between local and international rates. Professional and administrative staff locally recruited should be paid as close as possible to international scales.

It would be difficult to attract qualified expatriates to Dhaka to work for the long-term in the present BIWTA building. It might have sufficient square footage for a Centre, however, the quality of the work environment is inadequate to a Centre's takes. A quieter and more convenient location, closer to adequate housing and away from the city Centre noise and congestion is needed (the current Master Planning Organization (MPO) offices in Dhaka are a good model). Office equipment and facilities also appear inadequate. Better equipment will be needed. It should be noted that a number of these problems would also have to be addressed if a Centre was to be set up in other locations in the region.

CHAPTER 6

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6 SUMMARY AND CONCLUSIONS

This mission, the largest and most extensive of its type, visited nine countries, numerous facilities in these countries and interviewed more than 160 IWT officials in 2 1/2 months. Consequently, the mission's coverage was necessarily broad. While the coverage of countries and specific IWT problems vary, the mission is confident that it has observed and conveyed a good general picture of IWT in the ESCAP region.

Aside from the limitations which must be expected when covering such a wide area in a short time, the major gaps in the missions's observations are with the Philippines -- where more IWT probably exists than the mission was able to observe -- and with India, which the mission could not visit.

China is a special case. IWT in China is far more developed than it is in the rest of Asia. In certain areas, such as passenger transport, China is probably even more developed than Europe and the United States. In other areas, China seeks to reach the level of IWT development found in the industrialized countries. While the mission is confident in its general picture of IWT in China, and in its more specific observations on the Changjiang River, the mission members realize they have only "scratched-the-surface" in China.

Inland water transport is important, in varying degrees, throughout the region. However, its priority, as indicated by usually low percentages of national budgets, is often not in proportion to IWT's importance to many countries of the region. IWT needs higher visibility and better marketing throughout the region, especially among the relevant officials, potential donors and financing institutions. IWT can offer a good return on investment and is often the most appropriate technology for transport and communication problems faced by countries in the region.

Overall, the mission identified more than 160 important IWT issues and problems in the countries visited. Currently, the region has uneven capacity to deal with these issues and problems. The capacity which exists is usually not broad enough and is not effectively shared among countries of the ESCAP region.

The countries in the ESCAP region lack sufficient international coordination to effectively exchange IWT experience and skills. Each country tends to undertake its own studies. River basin planning of international rivers is generally weak.

Coordination problems also exist within the countries, among various organizations and ministries dealing with hydropower, irrigation, IWT and other water users. IWT should be, but frequently is not, included in country master planning. IWT usually falls within ministries other than those dealing with water resources. Therefore, total water management capacity suffers, as well as the capacity for IWT development. Master planning is weak throughout the region.

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Besides coordination problems at the international and national level, the mission also observed many coordination problems within particular river basins. These problems are particularly visible in the field of hydraulics and sediment analysis and surveying. The region has strong capabilities in these areas, when applied to near field analyses in estuaries, main ports, and near dams or barrages. However, when it comes to far field analysis which covers the river basin as a whole, the capability is generally inadequate. The reason for this inadequacy, is that the benefits of the near field studies are more highly visible.

IWT transport capacity is currently limited throughout the region. Failure to maintain navigable depths, sustain maintenance dredging, limited vessel design capacity and inadequate terminals -- all serve to limit transport capacity throughout the region. While some dredging capacity exists, it is probably not being optimally employed. The dredging which does exist should be better linked to IWT. The specific hydraulic and sedimentation conditions of the region need to be assessed against the available world-wide dredging technologies and the appropriate technologies chosen. Terminals for IWT are non-existent in some countries, and small scale or of low technology in others, particularly Bangladesh. The capacity for vessel design is also weak. Pakistan and Sri Lanka have largely lost their IWT capabilities, while Bangladesh has retained some expertise.

The socio-economic aspects of IWT are critical to countries throughout the region, but they are often not examined. Therefore, the true benefits and optimal investment strategies for IWT are rarely articulated. While a fair capacity for socio-economic analysis exists throughout the region, it is seldom tied to IWT and not coordinated among countries.

Retaining qualified IWT staff, particularly at the mid to high career management level, is a problem. While the problem varies among different countries, the general management situation reduces the region's capacity to operate IWT. While varying degrees of training exist, the region's training capacity for IWT needs substantial enhancement. This is particularly true of programmes to train managers and to "train-the-trainers."

Inadequate data on all aspects of IWT inhibit the capacity to operate and to develop IWT throughout the region. Among other types, data are required for trade, commerce, employment and other technical aspects of IWT. While limited capacity to generate and maintain data on IWT exists, that capacity is not coordinated and is generally insufficient.

Some IWT-specific research and development (R&D) is done in the region. However, most studies of IWT are financed from abroad. Likewise, a large percentage of IWT construction is foreign. Most countries in the region are strong in engineering but lack capacity to undertake major IWT project design, construction and management.

The mission has recommended 71 projects to deal with these issues. To help appropriate officials implement the recommended projects, the mission has classified 9 projects as critical, 18 projects as highly important and 44 as important. However, this classification is only meant to assist

implementation -- all 71 projects are the mission's recommended projects and should be implemented.

Some type of regional centralization of IWT support activities is the best way to implement all 71 recommended projects. The mission has identified and described two alternative ways to organize such centralized activities: a large-scale, full-service Centre or a small organization of highly mobile core staff and outside consultants.

Since Bangladesh has been mentioned as a possible Centre location and possible facilities were visited, the mission also recommends that the relevant officials address some of the pending issues: proper physical facilities, recruiting expatriates and other experts from within the region, and the difference in pay scales between Bangladesh and international rates.

Mission members are aware of the history and current discussion of a potential regional IWT Centre. This discussion should not delay beginning the implementation of the 71 recommended projects. These 71 recommended projects are the mission's first priority.

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CHAPTER 7

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## BANGLADESH

BIWTA map.

Mr. J.M. Deplaix's notes.

The feasibility of establishing an Inland Water Transport Centre in Bangladesh by the secretariat. (E/ESCAP/STC. 4/16, 13 November 1980.

The country boats of Bangladesh, February 1984, Institute of Social Studies, the Netherlands (Co-author).

Multimodal transport in Bangladesh.

A comprehensive study of the hydrologic, hydraulic and hydrographic aspects of the waterways, as well as an assessment of the needs in the field of maintenance and development of inland waterways and ports of this country, was made by the Netherlands Engineering Consultants (NEDECO) from 1963 through 1967.

Traffic studies in the field of IWT have been carried out to date by the transportation Consultants Inc. (United States) and the Economic Intelligence Unit (United Kingdom).

BIWTA statistics, reports, yearbooks, etc. BIWTA annual traffic reports.

Report of the working group on the third five-year plan of the ports, shipping and inland water transport sub-sector.

Studies have been carried out by the Economic Intelligence Unit and Netherlands naval architects under the Netherlands technical assistance of BITW.

Studies have been carried out by BIWTA with the assistance of ESCAP, as well as Netherlands experts.

In 1970 two ferro-cement boats were received from the Government of China. A Canadian private team (Canadian Hunger Foundation) and a Danish private firm are working on such prototype boats at Chittagong.

BIWTC has a yard at Narayanganj to make fibreglass hulls for speed boats. It has a future plan for building launches and other craft of bigger size.

Designs were initiated by NEDECO in the mid-1960s. All such river from structures are not designed by Bangladesh consultants with the active collaboration of BIWTA engineers and constructed by local contractors.

A study was carried out in 1979 by the Shipping Research Services (Norway) with the financial help of the World Bank.

Studies have been undertaken by the Economic Intelligence Unit.

Bangladesh. Particulars of BIWTA Dredgers.

Bangladesh. The Journal of NOAMI, editor by Dr. D. K. Das, National Oceanographic and Maritime Institute, Dhaka, Bangladesh, Vol. I, No. 1, December 1984.

Bangladesh. Kathmandu Backs Dhaka's Stand on Water Sharing. Bangladesh Observer, 17 February 1965.

Bangladesh: Problems of Project Management. Bangladesh Observer, 17 February 1985.

Bangladesh: Evaluation of the survey vessels at the disposal of the Hydrographic Department of the Bangladesh Inland, Water Transport Authority, April 1981, DELF.

Bangladesh: UN Project BGD 761005 River Research Institute, March 1980, INTERIM Reports 1 and 2.

Bangladesh. World Dredging Congress 1983, 19-22 April 1983 - Maintenance Dredging Inland Waterways of Bangladesh by A.M.M. Ghulam Kibria, Member (Engineering), Bangladesh Inland Water Transport Authority (BIWTA), Dhaka.

Bangladesh. World Dredging Congress 1983, April 19-22. 1983 - Dredging at the Port of Chittagong.

Bangladesh. NOAMI Annual General meeting 1984, National Oceanographic and Maritime Institute (NOAMI), editor by Dr. Dipal Kanti Das, REGISTRATION No. S-724 of 1980-81.

9

Bangladesh. Year Book 1982-1983, Country Moves with Us, Chittagong Port Authority.

Bangladesh. Summary of Courses of Bangladesh Institute of Marine Technology, Bangladesh.

Bangladesh. Department of Water Resources Engineering, Bangladesh University of Engineering & Technology, Dhaka.

Bangladesh. The Chittagong Port Authority Country Moves With Us.

Bangladesh. Fleet position 1982-1983.

Bangladesh. Table - Distances for Navigation Routes.

Bangladesh. Programme of Work and Budget for 1985 and 1986-87. Center of Integrated Rural Development for Asia and the Pacific.

Bangladesh: Organization Chart for BIWTA.

Bangladesh: BIWTA Plan for Establishment of a Regional Center.

BURMA

BURMA: Irrawaddy River Fact Sheet.

## CHINA

China: Seminar-Cum-Study Tour on Inland Ports and Waterways, the Peoples Republic of China, 30 August - 18 September 1981.

China: The present status of China's Inland Waterways, May 1983.

ESCAP: Developments in Shipping, Ports and Inland Waterway 7-13 December 1982.

ESCAP: Developments in Shipping, Ports and Inland Waterways 8-14 January 1985.

ESCAP: Report on the Seminar-Cum-Study Tour on Inland Ports and Waterways, 30 August - 17- September 1981 in China.

ESCAP: Establishment of a Regional Center in Bangladesh, Summary of Committee Meetings and Project Document for Phase I.

ESCAP: Development Problems in the Field of Inland Water Transport, 13N or 1980.

ESCAP: Meeting of Chief Executives Report, 3-4 September 1984 (Port Authorities) U.N. Inland Water Transport, 14-22 December 1977, Bangkok.  
U.N.: Report by Group of Experts on the Standardization of Rules of the Road and Signs and Signals in Inland Navigation, 21 March 1975.

INDONESIA

Directorate General Land Transport and Inland Waterways. "ESCAP/UN preparatory assistance mission" March 1985.

L'universite de Liege, "Inland Waterways and Ferries Training Centre."

ESCAP questionnaire, March 1985.

Terms of Reference for Study of Inland Waterways Transport in Central and West Kalimantan.

Rencana Pembangunan, Dilingkungan Kanwil V. Ditjendat (Proposal for the improvement of the facilities of the Directorate General Land Transport and Inland Waterways near Palembang: a.o. harbors for workboats) March 1985.

Note on dredging, registered IWT crafts and marine casualties. Directorate Inland Waterways and Ferry Service April 1985.

## MALAYSIA

Malaysia: List of Main Navigable Rivers in Sarawak. Kuching Port Authority  
Information Handbook, Information Handbook Malaysian Port Facilities  
Rajong Port Statistics.

## PAKISTAN

'Inland water transport mission', February 1985, reflecting the view of the Government of Pakistan on the prospects to develop IWT in the country.

Inland water route from Fort Qasim to Sukkur 1975 by NESPAK.

Navigation from Sukkur and Kalabagn, 1976 by WAPDA's Dams Monitoring Organization.

Feasibility Study of Inland Navigation in Pakistan by ACOP 1983.

Inland Navigation in Pakistan 1984 by Irrigation, Drainage and Flood Control Research Council of Pakistan.

Background Notes: ESCAP/Mr. J.M. Deplaix.

National Transportation Plan Study, December 1984, Ministry of Planning.

JICA (Japan International Cooperating Agency). (Mentioned, not seen).

List of structures (IWT obstructions).

Pakistan: Salient Features and Data of Kotri Barrage.

Pakistan: Sukkur Barrage Description.



## Philippines

Philippines: Phillipine Maritime Industry, 1982-1983. Maritime Industry Authority Pamphlet. Port of Manila Pamphlet. Overview of Phillipine Maritime Industry, by Rose Padre.

Philippines: Laguna De Bay, Water Resources Development, Volume I, general report September 1974. SOG REAH (France) and Volume 4 & 5, Hydraulic Control Structures, April 1974.

Philippines: Framework Plan, Eastern Visayas, Samar Basins; under PHI/77/S03, Assistance to the NWRC, December 1979.

Philippines: Report on the Transport Sector in the Philippines, World Bank, September 14, 1983.

SRI LANKA

Brohier, R.L. "Legacies of the Colonial Dukar Engineer" Transactors of the Engineering Association of Ceylon.

Brohier, R.L. "A Book of Dutch Ceylon", Ch. 5 "Canals and Navigation", pp 120- 28.

Min. of Housing and Construction "Feasibility Report on the Development of Canals in Ceylon for Transport Purposes: Preliminary Stage I - Colombo - Puttalam Canal", State Engineering Corporation, Research and Development Section, September 1970.

Seminar on Water Transport and Canal Development, 17th February 1975. (i) Fernando, A.D.N., "Integrated Development of Canals, Muthurajawela Fields and Negombohagoon." (ii) de Fonseka, K.S.C. "Methods and Techniques for Canal Development in Sri Lanka". (iii) Diandas, J. "Economics and Water Transport" (iv) Amarkone, N. "Canal Projects".

Witteveen and Bos "Rehabilitation of the Colombo Puttalam Canal: Report Phase II, Stage 1, of Technical Cooperation", September 1977.

Netherlands Economic Institute, "Transport Economic Feasibility Assessment of Rehabilitation of the Colombo-Puttalam Canal; June 1981.

Economic Review, "Special Report, Inland Waterways - The Colombo - Puttalam and other Canals", Vol 7, No. 5, August 1981, People's Bank, Colombo.

Kurukulasuriya, S.B. "Canal Development", paper presented to Canal Pollution Research Seminar, Slaas, 5th November 1981.

ESCAP "Review of the Developments and Problems in the ESCAP Region with Regard to (a) Inland Waterway Transport and (b) Inland Waterways", SPIW/IWTIWA (1)/3, 12th May 1982.

ESCAP "Developments in Inland Waterways", E/ESCAP/STC.6/3, 13th October 1982.

Deplaix, J.M. "Report on a Mission to Sri Lanka", November 1982 (UN-ESCAP IWT Expert).

ESCAP "Review of Developments in Shipping Ports and Inland Waterways", E/ESCAP/STC.8/1, 13th December 1984.

## THAILAND

Thailand. 1984 Information Booklet. Accounting and Finance Department, State Railway of Thailand.

Thailand, World Bank Mission Backs Container Plan, Bangkok Post, Wednesday 27 February 1985.

Thailand. E/ES/STC. 6/3 - Review of Developments in Inland Waterways Committee on Shipping, and Transport and Communications (Shipping, Ports and Inland Waterways Wing), Sixth session, 7-13 December 1982, Bangkok.

Thailand, SPIW/IWTIWA(1)/3 - Review of the Developments and Problems in the ESCAP Region with Regard to (a) Inland Water Transport and (b) Inland Waterways, Meeting of Chief Executives of Inland Water Transport. Inland Waterways Authorities, First session, 3-4 June 1982, Bangkok.

Thailand. Inland Water Transport.

Thailand. 1984 Summary of Commodities Passed through Navigation Locks.

Thailand: Commodity Cost Report for Lockages.

Thailand: Cross Profile of Chao Phraya River.

Thailand: Map of navigation Projects.

Thailand: Nan and Chao Phraya River Training, undertaken by RID from 1965 to 1981.

Thailand: River Training for Navigation and Bank Protection of the Royal Irrigation Department, Bangkok by Jumsak JeJasen, January 1973.

Thailand: The Inland Waterway Projects of Thailand under Construction, 16-28 December 1980. Facilities, Bangkok Port.

Thailand: Chao Phraya - Meklong Basin Study, Phase 1 - Executive Summary, March 1979.

USA

USA Civil Works Overview, EP 360-2-1, Sept. 1982.

USA National Waterways Study - A Framework for Decision-Making Report, January 1983, Final Report NWS-83-1, National Waterways Study, U.S. Army Engineer Water Resources Support Center, Institute for Water Resources.

USA Criteria for the Depths of Dredged Navigational Channels, Marine Board, Commission on Engineering and Technical Systems National Research Council.

US Department of Transportation: Inland Waterway User Taxes and Charges, Feb 1982.

US Department of the Army, Corps of Engineers, User Charges for the Use of Inland Shallow Draft Waterways.

UNITED KINGDOM

UK Report on Advisory Visit to Port Qasim, Pakistan, 26 December - 28 January  
1984 by K. Dixon Mbe, Hydrographic Consultant, Hydrographics Research,  
Wallingford.